United States Department of Agriculture

Natural Resources Conservation Service

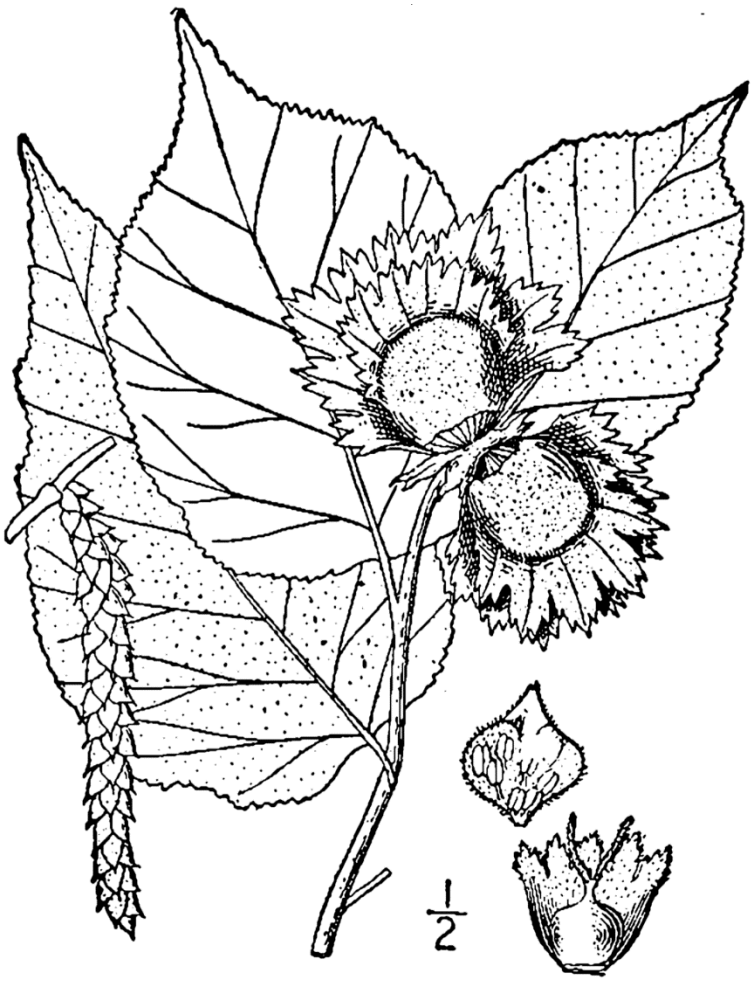
Plant Materials Center

Bismarck, North Dakota

August 2015

Technical Report, 2014

Part 2 of 2: Trees and Shrubs



American hazelnut
Corylus americana

Credit: USDA-NRCS PLANTS Database / Britton, N.L., and A. Brown. 1913. *An illustrated flora of the northern United States, Canada and the British Possessions. 3 vols.* Charles Scribner's Sons, New York. Vol. 1: 607

United States Department of Agriculture
Natural Resources Conservation Service
Bismarck Plant Materials Center

Technical Report

Part II (Trees and Shrubs)

2014

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PART II

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INTRODUCTION

INTRODUCTION: TECHNICAL REPORT – 2014

Objectives and Functions

The USDA Natural Resources Conservation Service (NRCS), Plant Materials Center (PMC), Bismarck, North Dakota, primarily serves the States of Minnesota, North Dakota, and South Dakota. Activities are directed toward meeting the needs and priorities set forth in the three States' long range programs.

The objectives and functions of the Plant Materials Center are to:

1. Identify, select, and improve plants to meet the resource conservation needs of the three States.

2. Determine techniques for successful propagation and establishment of these plants.

3. Assemble and comparatively evaluate materials on and off the Center.

4. Make comparative field plantings for final testing of promising plants and techniques with conservation districts and cooperators.

5. Work with universities, experiment stations, and other State and Federal agencies to cooperatively release improved conservation plants.

6. Produce limited quantities of foundation or foundation quality seed. This seed is made available to conservation districts, state seed certifying organizations, commercial seed growers, or other agencies for establishing seed increase fields or seed orchards.

7. Encourage conservation districts, commercial seed growers, and commercial and State nurseries to produce adapted plant materials and named cultivars.

8. Promote improved conservation plant materials in conservation programs.

One of the major objectives of the PMC is to improve the quality and quantity of native and introduced trees and shrubs available for field and farmstead windbreaks, erosion control on cropland and critical areas, recreation areas, wildlife habitat, edible fruits and nuts, and barrier plantings.

The NRCS has agreements with soil conservation districts, State universities, and other State, Federal, and local agencies at four locations in Minnesota, North Dakota, and South Dakota to provide cooperative off-center sites with long-term land tenure for testing woody plant materials. These agreements provide sites for assembly and initial evaluation of trees and shrubs under diverse soil and climatic conditions. They represent major land resource areas and key windbreak suitability groups. Initial evaluations are recorded on individual spaced plants or rows under uniform culture and management conditions.

Location

The Bismarck Plant Materials Center is located in south central North Dakota, near the center of the North American landmass. It is on the east bank of the Missouri River in a shallow basin 7 miles wide and 11 miles long. Elevation is 1,647 feet, latitude 46º46'N and longitude 100º45'W.

Physical Facilities and Evaluation Sites

The PMC does not own land but manages a total of approximately 60 acres on Lincoln-Oakes Nursery. Three off-center evaluation sites are located in Minnesota, South Dakota, and North Dakota.

1. Lincoln-Oakes Nursery, Bismarck, North Dakota. The USDA Natural Resources Conservation Service, Plant Materials Center operates under a cooperative working agreement with the North Dakota Association of Soil Conservation Districts (NDASCD). The Association owns and operates the Lincoln-Oakes Nursery which in turn provides the PMC with 60 acres of land located on the nursery. This site is primarily used by the PMC for foundation quality grass seed production. The PMC shares a building site with the Nursery, with the NRCS buildings located on the north part of the acreage. Buildings include an office, greenhouse, lathhouse, old office/storage building, machine storage shed (housing tree and seed storage refrigeration units), seed cleaning building, chemical storage shed, and a two equipment storage buildings with one containing a shop.

2. Off-center evaluation sites in Minnesota, South Dakota and North Dakota. These three off-center evaluation sites, located in the three-State area, are cooperative with various State and Federal agencies. These locations provide long-term testing sites for trees, shrubs, and grasses evaluated under uniform culture and management. Refer to map, page 9.

Soils

At the PMC, the soil type is a Mandan silt loam. The Mandan series typically consists of deep, well-drained soils formed in silty sediments on uplands and terraces. The surface layer is dark grayish-brown and grayish-brown silt loam 20 inches thick. The subsoil is grayish-brown silt loam 9 inches thick. The underlying material is 28 inches of light brownish-gray silt loam over light brownish-gray loam. Slopes range 0 to 7 percent. Ordinarily, surface runoff is medium and fertility is high. Controlling erosion is the major concern in management. Both soil blowing and water erosion are hazards. This soil is well-suited to small grain, corn, and alfalfa. Capability unit IIe5, windbreak group 3.

Climatological Information and Weather Summary

Climate of the area is semiarid, typically continental in character. During the summer, there are a few hot and humid days, but the winters are quite cold and fairly long. The relative humidity during the summer is generally low, and high temperature and high humidity are seldom experienced together.

Normal precipitation is 16.84 inches per year. Refer to Table 1 on page 4 for 2014 weather data. More than 75 percent of this falls during the six-month period of April through September, and 50 percent normally falls in May, June, and July. Most summer precipitation occurs during thunderstorms that occur about 34 days per year. Damaging hail occurs about once in 10 years.

The winter season begins in late November and continues until late March. Nearly all winter precipitation is snow, often associated with strong winds and low temperatures. Snow has been reported for all months except July and August. Occasional winter blizzards can be severe.

Temperatures range from an average mean of 6.7 degrees F in January to a mean of 70.4 degrees F in July. During short periods, the temperatures may climb as high as 100 degrees F in summer or drop as low as -40 degrees F in winter. Frequent clear and partly cloudy days contribute to a high percentage of possible sunshine, with the total annual average about 2,700 hours out of a possible 4,470 hours. The average wind speed is a little less than 11 miles

per hour, with a prevailing direction from the west-northwest. April and May are the windiest months. The average freeze-free period is 134 days from mid-May to late September.

Table 1: 2014 Weather Summary - Official Station - Bismarck, North Dakota

	Mean Temperature (degrees Fahrenheit)		Precipitation (inches) Actual		Deviation from Normal
Month	**2014**	**Normal***	**2014**	**Normal***	**2014**
January	13.8	12.8	0.38	0.43	-0.05
February	9.6	18.1	0.19	0.50	-0.31
March	27.2	29.9	0.82	0.86	-0.04
April	41.1	43.8	1.95	1.26	0.69
May	55.8	55.5	0.85	2.39	-1.54
June	63.4	64.6	3.02	3.16	-0.14
July	68.5	71.1	0.73	2.88	-2.15
August	68.7	69.5	4.75	2.27	2.48
September	60.2	58.5	0.37	1.59	-1.22
October	47.8	44.8	0.15	1.25	-1.10
November	21.5	29.2	0.60	0.71	-0.11
December	19.8	16.2	0.11	0.48	-0.37
Annual	**41.5**	**42.8**	**13.92**	**17.80**	**-3.86**

*National Climate Data Center 1981-2010 Monthly Normals

	2014
Last Frost (28 degrees)	17-May
First Frost (28 degrees)	3-Oct
Frost Free Period	138 days

REGIONAL DESCRIPTION

REGIONAL DESCRIPTION: TECHNICAL REPORT – 2014

Major Land Resource Areas

The three States served by the PMC, Minnesota, North Dakota, and South Dakota, include portions of 23 Major Land Resource Areas in four Land Resource Regions. They are the Northern Great Plains Spring Wheat Region, Western Great Plains Range and Irrigated Region, Northern Lake States Forest and Forage Region, and the Central Feed Grains and Livestock Region.

Potential Natural Vegetation

Most of central and western North and South Dakota support a mixed grass prairie of predominantly western wheatgrass (*Pascopyrum smithii*), green needlegrass (*Nassella viridula*), needleandthread (*Hesperostipa comata*), slender wheatgrass (*Elymus trachycaulus*), and prairie junegrass (*Koeleria macrantha*). Little bluestem (*Schizachyrium scoparium*), sideoats grama (*Bouteloua curtipendula*), plains muhly (*Muhlenbergia cuspidata*), sedge (*Carex*), and blue grama (*Bouteloua gracilis*) are the principal climax species on xeric soils, steeper eroded slopes or thin uplands. Prairie sandreed (*Calamovilfa longifolia*) is important on sandy soils throughout the region. Moist sites support such species as big bluestem (*Andropogon gerardii*) and prairie cordgrass (*Spartina pectinata*). Whitetop (*Scolochloa festucacea*), bulrushes (*Scirpus*), and common reed (*Phragmites australus*) are typical of lowland meadows and marshes. Western snowberry (*Symphoricarpos occidentalis*), rose (*Rosa*), buffaloberry (*Shepherdia argentea*), and chokecherry (*Prunus virginiana*) are abundant shrubs in draws and narrow valleys. Rocky Mountain juniper (*Juniperus scopulorum*) is common in the western Badlands. Eastern South Dakota, southern Minnesota, and the Red River Valley support vegetation dominated by tall grass prairie species; principally big bluestem, switchgrass (*Panicum virgatum*), and Indiangrass (*Sorghastrum nutans*). Other important species include little bluestem, prairie dropseed (*Sporobolus heterolepis*), porcupine grass (*Stipa spartea*), green needlegrass, and prairie cordgrass. Bur oak (*Quercus macrocarpa*), basswood (*Tilia americana*), hackberry (*Celtis occidentalis*), cottonwood (*Populus deltoides*), and willow (*Salix*) follow major draws and floodplains. Green ash (*Fraxinus pennsylvanica*) is found in all three states. In the western Dakotas it comprises up to 70 percent of the tall trees in forests. The presence of emerald ash borer (*Agrilus planipennis*) in Minnesota puts the ash resource at risk.

Two distinct forested regions occur within the three-State area. The first is the Black Hills of South Dakota where Ponderosa pine forest (*Pinus ponderosa*) and pine/oak savannas dominate. The second is the northern and eastern sections of Minnesota, which support mixed hardwood and conifer forests. Principal species include oak (*Quercus*), maple (*Acer*), elm (*Ulmus americana*), aspen (*Populus*), jackpine (*Pinus banksiana*), red pine (*Pinus resinosa*), and balsam fir (*Abies balsamea*). Black spruce (*Picea mariana*), tamarack (*Larix laricina*), and white cedar (*Thuja occidentalis*) are typical of lowlands and swamps.

Climate and Species Adaptation

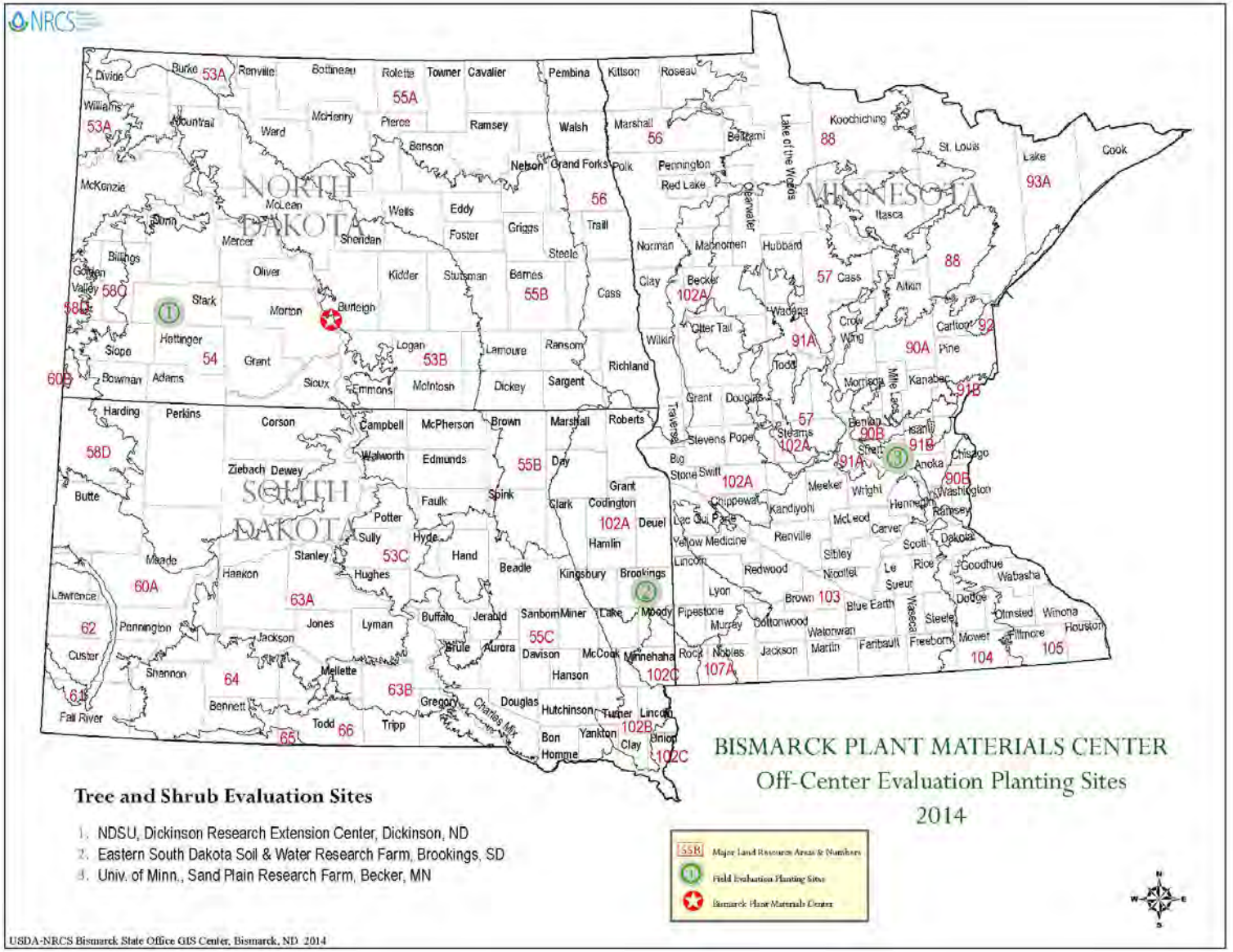
North Dakota and Minnesota are the two coldest States in the nation excluding Alaska. Mean annual temperatures range from 36 degrees F to 48 degrees F for all reporting stations. Plant hardiness zones (USDA) vary from 2 to 5 with mean minimum temperatures between -10 degrees F and -50 degrees F. Annual precipitation varies from 13 inches in western North Dakota to 30 inches or more in southeast Minnesota. Growing seasons are short, averaging from 110 to 150 days. The central and western Dakotas are principally semiarid in nature while the eastern Dakotas and Minnesota are considered subhumid.

The diversity of woody species is limited because of cold and drought, especially in the Dakotas. The scarcity of native tall tree species for windbreaks has relegated at least a portion of the tree improvement effort in the Northern Great Plains to improving upon existing cultivars of native species or increasing survival and pest resistance of hardy exotics such as Siberian elm. Species from Siberia, Russia, Manchuria, or Mongolia are among the most viable introductions for prairie plantings where precipitation is generally less than 20 inches annually. There is generally little shortage of shrub species suited for shelterbelt, barrier, or wildlife plantings except in the most hostile environments or specific cases related to pest resistance.

The short growing season limits the potential annual growth rate of trees. Late spring frosts can affect fruit set of early flowering fruit trees following a week or so of warm temperatures. However, hardy native shrubs like plum, chokecherry, and hawthorn are well adapted and regularly produce abundant crops. Indigenous species may rely on a secondary bud flush to produce foliage in some years. Winter desiccation of needle leaved evergreens is not uncommon on exposed sites, making conifer establishment a challenge for vast areas of the Northern Plains. Symptoms of winter injury on hardwoods may be as mild as tip dieback on exterior limbs to complete death of above ground stems and subsequent resprouting. Damaged trees are ideal sites for insects and disease infection.

The importance of adapted seed sources and the need for provenance tests is especially critical in the extreme and variable environment of the Northern Plains. In the three-State region served by the PMC, winter hardy, drought, and pest resistant cultivars are in demand by the nursery trade. Seed sources from regions further south frequently express superior growth rates but are more susceptible to winter injury.

MAPS


NRCS
NORTH DAKOTA
SOUTH DAKOTA
MINNESOTA
Tree and Shrub Evaluation Sites
1. NDSU, Dickinson Research Extension Center, Dickinson, ND
2. Eastern South Dakota Soil & Water Research Farm, Brookings, SD
3. Univ. of Minn., Sand Plain Research Farm, Becker, MN
BISMARCK PLANT MATERIALS CENTER
Off-Center Evaluation Planting Sites
2014
55B Major Land Resource Areas & Numbers
Field Evaluation Planting Sites
Bismarck Plant Materials Center
USDA-NRCS Bismarck State Office GIS Center, Bismarck, ND 2014

ASSEMBLY AND INITIAL EVALUATION STUDIES

Off-Center Evaluation Plantings

OFF-CENTER EVALUATIONS: TECHNICAL REPORT – 2014

Study 38I316K North Dakota State University, Dickinson Research Extension Center, Dickinson, North Dakota.

Study Title: Field Evaluation of Woody Plant Materials.

Introduction: There is a need to evaluate the performance of shrub and tree species/cultivars for windbreaks, wildlife, and recreational plantings under diverse soil and climatic conditions. To meet this need, field evaluation planting sites representative of the Major Land Resource Areas were located in the three States served by the PMC. These sites provide planting locations under long-term land tenure, for assemblies of trees and shrubs to be evaluated under uniform culture and management. New material can be added on an annual basis. Comparisons are then made with previously released cultivars and area of adaptation determined.

Objective: The objective is to assemble and evaluate woody plant materials for conservation use. Superior cultivars will be selected and released for increase by commercial nurseries.

Cooperators: The USDA Natural Resources Conservation Service, Plant Materials Center, Bismarck, North Dakota, in cooperation with the North Dakota State University, Dickinson Research Extension Center (DREC), Dickinson, North Dakota. The cooperative agreement expired January 20, 2010, and a new 15-year agreement was finalized in 2012.

Location: This project is located on the west edge of Dickinson, North Dakota, on the NDSU Dickinson Research Extension Center. Legal description: NE 1/4 sec. 5, T. 139 N., R. 96 W., Stark County, North Dakota.

Major Land Resource Area: The site is located in Major Land Resource Area 54, Rolling Soft Shale Plain. This moderately dissected rolling plain is underlain by calcareous shales and sandstones. Strongly dissected areas of sharp local relief or badland topography border major streams and valleys in some areas. Elevation is 2,411 feet. Sixty percent of the area is rangeland.

Soils: The soil type is a Parshall fine sandy loam. The Parshall series consists of deep, well-drained soils formed in fine sandy loam alluvium on terraces and outwash plains and in upland swales. The surface layer and subsoil is dark grayish-brown fine sandy loam. The underlying material is dark grayish-brown fine sandy loam and loamy fine sand. Permeability is moderately rapid. The available water capacity is moderate. Organic matter is high and fertility is medium. This soil is in North Dakota conservation tree and shrub group 5.

Climate: For MLRA 054, the average annual precipitation is 13 to 19 inches; increasing from west to east for this semiarid area. Rainfall is highest from late spring to midsummer and very low during the rest of the year. Winter precipitation is snow. Average annual temperature is 40 to 45 degrees F. Average freeze-free period is 110 to 135 days. The plant hardiness zone is 4a, with an average annual minimum temperature of -30 to -25 degrees F. Climatic data for 2013 recorded at Dickinson Research Extension Center, Dickinson, North Dakota, is shown in Table DI-1.

Methods and Materials

Assembly: Refer to Table DI-2 for a list of woody species planted from 1978 through 2014.

Planting Plan: Plots are not randomized or replicated but systematically arranged for ease of evaluation and demonstration purposes. The planting site is approximately 500 feet long and 200 feet wide. The area is divided into five blocks. Each block consists of single row, non-replicated plots. Each plot contains a minimum of 5 plants. Row length is 100 feet and spacing between rows is 20 feet. Block 1A contains mainly tall tree accessions. Block 1B contains conifers. Block 2 contains shrubs and small trees. Block 3 contains medium sized trees. Block 4 contains tall trees. Refer to the plot map in Figure DI-1 and the aerial map in Figure DI-2. All trees are spaced ten feet within row and shrubs are spaced five feet within row. All rows run from west to east. Like species and standards of comparison are established in adjacent plots whenever possible.

A new study area (west planting) of 1.1 acres was added west of the original block (east planting) in 2012.

Plot Preparation: In 2011, DREC staff chemically and mechanically fallowed a 5-acre plot immediately west of the current study area. Part of this area is an expanded tree research area for the PMC. PMC staff seeded the entire new study area (west planting) to blue grama. In early summer 2012, PMC staff stapled four 150-foot strips of weed barrier (6-foot wide) to the ground in preparation for future planting. Using blue grama and weed barrier reduces the risk of mechanical damage to planted stock. It should also reduce DREC maintenance time. New accessions are now planted each year into the fabric. Removal is planned for 14 accessions in the original block for which data is no longer needed or the accessions have mostly died. Once removed, that area of the east planting will be leveled and seeded to ease weed control for DREC staff.

Planting Method: All trees and shrubs are hand planted using approved forestry methods.

Planting Date: Refer to Table DI-2 for planting dates of woody species planted from 1978 through 2014. If available, replacement stock is planted after establishment year.

Fertilization: No fertilizer has been applied to planting area.

Weed Control: Initially, no herbicide was applied to any plot during year of establishment or in succeeding years. Weeds were controlled by clean cultivating between rows, within row, and in fallow areas. Four to six tillage operations were performed each year in the months of May through August. A minimum of hand hoeing was done to control weeds in rows. In recent years, DREC staff have been spot-spraying glyphosate where invasive weeds are an issue. A near-term goal has been to seed blue grama grass between the tree rows once the weeds are under control, the trees are pruned back, and the soil has been smoothed out enough to allow seeding. That will alleviate the need for cultivation in the East Block, and will allow mowing as the main weed control option.

Pest Control: No animal repellents or insecticides were applied in 2014. Glyphosate was used for spot control of invasive weeds.

Irrigation: No irrigation was applied as 2014 was extremely wet.

Crop Residue Management: Regular tillage for the past several decades has kept overall weed pressure reduced, but tillage operations have damaged the test plantings by tilling out material, breaking or bruising limbs and trunks, or removing identification stakes. Ongoing tillage has also created an environment for extensive water erosion of uphill plantings northwest of the east planting, and those eroded soils are being deposited in this block. In the newer west planting, blue grama was seeded over the entire site one year prior to tree establishment. In-row fabric is applied prior to transplanting the new additions to this block. This site is now maintained by regular mowing, when needed.

Silvicultural Practices: There is ongoing pruning and removal maintenance of the east plantings.

Added Species and Rationale: On May 13, 2014 the following species were planted:

- 'Catskill' dwarf sand cherry *Prunus pumila* var. *depressa* L., accession 9051508 from Big Flats Plant Materials Center, Big Flats, New York, planted in row 13 of west planting. A non-invasive 1997 release with prostrate growth and immense root system. It grows well on gravelly or sandy soils along streams but has performed well on silt loam and calcareous soils. It is often used in shoreline and stream bank stabilization practices and riparian buffer plantings, where low vegetation is preferred, including areas with ice floe issues. Suggested adaptation is hardiness zones 3b to 6b.
- Swamp white oak *Quercus bicolor*, accession 9094441 (Illinois source) from Lawyer Nursery, Plains, Montana, planted in row 3 of west planting. This species is performing well at the Becker, MN offsite location in extremely sandy soils.
- Gray birch *Betula populifolia*, accession 9094442 (Wisconsin source) from Lawyer Nursery, Plains, Montana; planted in row 2 of west planting. Gray birch is performing well at the Becker, Minnesota offsite location in extremely sandy soils after many years. It will be interesting to see how it performs in this location with heavier clay loam soils. There is demand for a birch tree for conservation use, and this will be a good location to evaluate its performance.
- Lodgepole pine, *Pinus contorta* var. *latifolia* accession 9092231(Mandan ARS source) from NDFS Nursery, Towner, ND; planted in east planting, block 1B, row 6, plots 5-10. Lodgepole pine is a tall,

straight-trunked, narrow-crowned pine, native to the Rocky Mountain and Cascade-Sierra Ranges. It prefers reasonably moist, well drained fertile soils, but has proven to be drought tolerant once it is established. It grows well in soil pH 5.0 to 7.5 and Windbreak Suitability Group - 1, 3, 4, 5. Its tolerance to higher pH soils (up to pH 8.2) needs to be investigated. Lodgepole pine is used as a food source by a variety of birds, squirrels, and porcupine. This is a composite of five seed sources that scored well in tests at the Agricultural Research Station in Mandan for the past 30 years and at two North Dakota field locations for the past 7 years. In PMC trials, it exhibited darker green foliage than did ponderosa pine or Mongolian Scots pine. Early growth rates and foliage density were similar to ponderosa pine.

Evaluations and Measurements

Previous years: Records of planting date, survival, vigor, canopy width, height, cold hardiness, animal damage, insect damage, disease symptoms, and unusual or outstanding features have been maintained since 1978 and are listed in Table DI-2. Plant performance data is recorded during the growing season for the first three years. After the third year, data is gathered according to a specific schedule. Select data appears in this report. Annual summary reports have been prepared since 2006 and can be requested from the PMC.

2014 Notes and Observations: Information was collected on 30 selected entries on September 9, 2014. Crown spread and plant height were recorded along with observational notes relative to disease and insect damage, drought and cold tolerance, fruit production, survival, vigor, and predator damage. This area experienced a very wet spring and growing season during 2014, almost two times above normal. All of the species added in 2013 and 2014 appeared to be establishing well and showing good vigor.
A mid-winter evaluation was also completed to determine maintenance activities to be completed in the near future. After consultation with DREC and PMC staff, the following plan was developed:
Tree/shrubs to remove:

- All honeysuckle (7 accessions). Most have been in the test plots over 25 years. No future study is anticipated. There is concern by public and land management agencies that these honeysuckle species can easily spread offsite and contaminate natural areas.
- Three crabapple accessions. They are 35 years old and mostly dead.
- 'Regal' Russian almond. Recent measurements evaluated suckers, since the original plant material died and was replaced by root sprouts. Superior plants have already been selected and it has been released and incorporated in the NRCS Field Office Technical Guide. A seed orchard is established at the PMC.
- Survivor Germplasm false indigo. This plot is full of contaminant shrubs spread by birds. Original plants have died and measurements are on the suckers. It has been released and is in the NRCS Field Office Technical Guide. A seed orchard of this release is established at the PMC.
- Siberian salt tree
- Cotoneaster

Other maintenance:

- Add tree shelters to Prairie Harvest germplasm hackberry at IV/7/1-5.
- DREC staff will remove marked species. The PMC marked () species to be removed with tree paint
- Several trees should be pruned to improve form, clean old wounds, and raise canopies for access. Hawthorn needs. The canopy of the hawthorn needs to be raised to reduce danger to staff and public.
- DREC staff will continue the excellent herbicide weed control (similar to what was done in 2014) to prepare the Block 1 site for fall leveling and smoothing between the tree rows and seeding grass between the rows in 2016. PMC staff will assist in correctively pruning and raising canopies on some species to facilitate seeding. The PMC will assist with seeding blue grama between those rows in the spring of 2016.
- PMC staff will install fabric on swamp white oak, row 3.
- Coppice assorted shrubs (skunkbush sumac, Pekin lilac, etc.) to rejuvenate planting.

The following accessions exhibit potential for further evaluation and use:

Accession Number	Genus/Species Origin/Source	Plot Location
ND-1765 9005980	Siberian larch *Larix sibirica* USDA, FS, Shelterbelt Lab., Bottineau, ND	1B/03/1-10
ND-1873 9005648	Amur maple *Acer ginnala* Lincoln-Oakes Nursery, Bismarck, ND	3/09/1-5
SD-156 9005890	green ash *Fraxinus pennsylvanica* Deuel Co., Clear Lake, SD	4/01/1-5
ND-1879 9011850 PI-503531	honeylocust *Gleditsia triacanthos* ARS Field Station, Woodward, OK	4/04/1-5
SD-75 9005713	hackberry *Celtis occidentalis* Potter Co., SD	4/9/1-10
9069090	quaking aspen *Populus tremuloides* Lee Nursery, Fertile, MN	1A/5/6-10
9069168	Siberian larch *Larix sibirica* Altai Region, Russia	1A/09/6-10
9057413	Ponderosa pine *Pinus ponderosa* Glendive, MT NDFS	1B/05/1-5
ND-3803	white poplar *Populus alba* USDA, NRCS, PMC, Bismarck, ND	1B/07/6-10
9063148	corktree *Phellodendron sachalinense* Clay Co., MN	1B/09/1-5
9076737	black cherry *Prunus serotina* Apple Valley OCEP, ND Lincoln-Oakes Nursery, Bismarck, ND	II/07/1-5
9092231 14070 ARS	lodgepole pine *Pinus contorta* var. *latifolia* Routt National Forest, Salida, CO	1B/06/6-10
9069081	littleleaf linden *Tilia cordata* Lee Nursery, Fertile, MN	1B/10/1-5
9082638	western blue elderberry *Sambucus nigra* ssp. *caerulea* Lincoln Oakes Nursery, Bismarck, ND	II/06/11-15

Figure DI-1. Off Center Evaluation Planting (east planting) Map at Dickinson Research Extension Center, Dickinson, North Dakota
The plot location of those species/varieties scheduled for removal is indicated by an X.

	Block 1A		Block 1B		Block 2		Block 3				Block 4	
Row 1			ND-1729 Siberian larch						'Red Splendor' crabapple		SD-156 green ash	ND-1734 green ash
Row 2	9082885 aspen	9082619 green ash	SL-383-T Siberian larch		9082684 smooth sumac	9008183 Sheridan source chokecherry			'McDermand' Ussurian pear		'Cardan' green ash	ND-1759 green ash
Row 3	14392 Walker poplar	Canam Walker poplar	ND-1765 Siberian larch			ND-170 cotoneaster		9063143 red tatarian honey-suckle	Survivor Germplasm false indigo	'Arnolds Red' honey-suckle	ND-647 black ash	ND-1432 Ohio buckeye
Row 4	ND-3796 white poplar	Raverdeau poplar	ND-1763 Ponderosa pine	ND-1565 bristlecone pine		'Regal' Russian-almond	'Konza' aromatic sumac			'Legacy' late lilac	ND-1879 honeylocust	'Carmine Jewel' dwarf cherry
Row 5	9082640 Gambel oak	9069090 quaking aspen	9057413 ponderosa pine	9069169 Siberian pine	ND-11 amur honeysuckle	'Centennial' cotoneaster	'Sakakawea' silver buffaloberry		'Magenta' crabapple		9063116 black ash	9091968 Kentucky coffeetree
Row 6	9087732 bur oak	Assiniboine poplar	9069172 Scots pine	9092231 lodgepole pine	9057406 rugosa rose	9082638 western blue elderberry	9076726 tatarian maple		9091969 Russian peashrub		9063115 green ash	9076724 Russian olive
Row 7	9063141 eastern cottonwood		9094406 Princeton elm	ND-3803 white poplar	9076737 black cherry	'McKenzie' chokeberry	9082891 common ninebark		9082653 skunkbush sumac		Prairie Harvest hackberry	9069166 Russian olive
Row 8	Hunter ponderosa pine	Bridger-Select juniper	9091967 pin cherry	Riverview Germplasm black currant	9063142 Japanese cherry	9082713 Siberian peach	'Prairie Red' plum		ND-629 amur maple		'Oahe' hackberry	
Row 9	9069164 Scots pine	9069168 Siberian larch	9063148 corktree	ND-21 nannyberry	'Homestead' Arnold hawthorn		ND-1873 amur maple		ND-686 Pekin lilac		SD-75 hackberry	
Row 10	9082641 pinyon pine	9082889 mugo pine	9069081 littleleaf linden	9063126 Japanese elm	/common juniper	salt tree/ bittersweet	9069129 amur chokecherry			9094355 roughleaf dogwood	9094356 Meyer's spruce	
	Block 1A		**Block 1B**		**Block 2**		**Block 3**				**Block 4**	

Figure DI-2. Off Center Evaluation Planting (west planting) Map at Dickinson Research Extension Center, Dickinson, North Dakota

	Block 1					
Row 1	'Berry Blue' honeyberry	'Cinderella' honeyberry	9094418 American hazel			
Row 2	9094417 Manchurian ash	9094416 sycamore	9094442 gray birch			
Row 3	909441 swamp white oak					
Row 4						
Row 5						
Row 6						
Row 7						
Row 8						
Row 9						
Row 10						
Row 11						
Row 12						
Row 13	'Catskill' sand cherry					
	Block 1					

*Between row spacing is 25 feet.

Figure DI-3. Aerial Map of Off-Center Evaluation Planting at Dickinson Research Extension Center, Dickinson, North Dakota

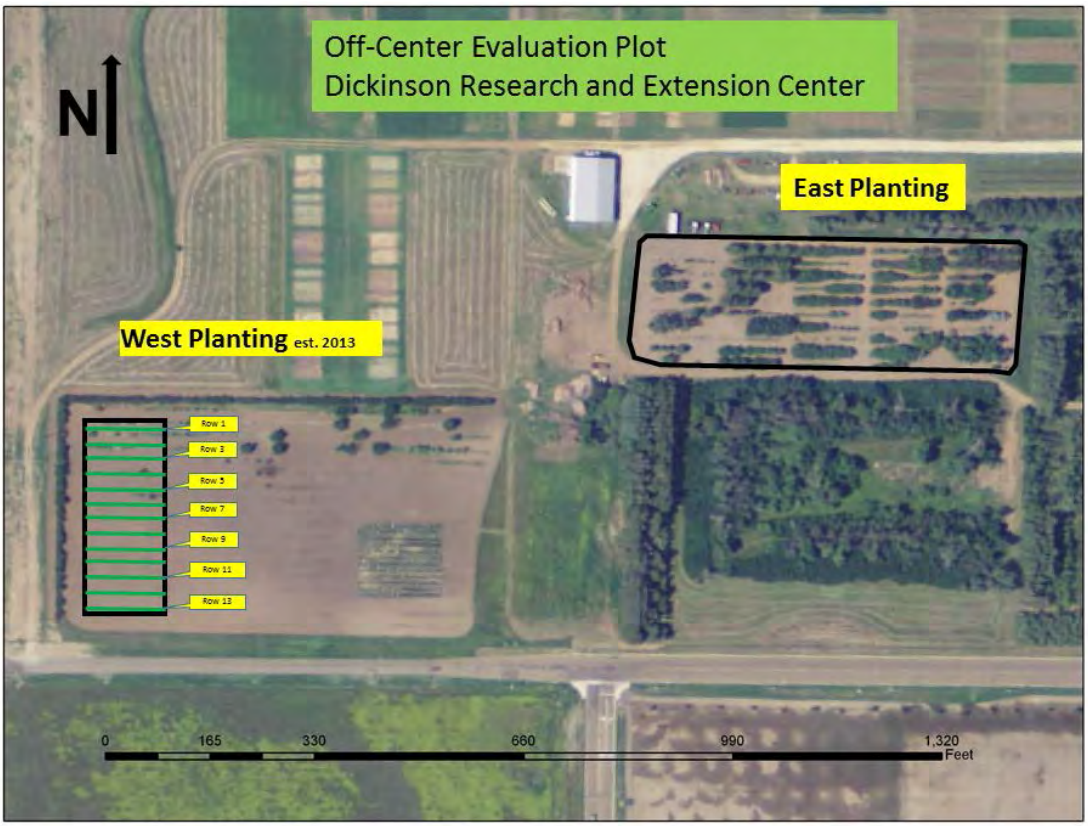


Table No. DI-1: 2014 Weather Summary - Official Station - Dickinson, North Dakota

	Mean Temperature (degrees Fahrenheit)		Precipitation (inches) Actual		Deviation from Normal
Month	**2014****	**Normal***	**2014****	**Normal***	**2014**
January	M	16.8	M	0.29	n/a
February	M	21.0	M	0.33	n/a
March	M	30.6	M	0.69	n/a
April	M	42.9	M	1.47	n/a
May	M	53.7	M	2.32	n/a
June	M	62.7	M	3.20	n/a
July	M	69.8	M	2.44	n/a
August	M	68.9	8.45	1.53	6.92
September	M	57.7	1.14	1.47	-0.33
October	M	44.4	0.35	1.23	-0.88
November	M	30.0	0.38	0.54	-0.16
December	M	18.4	0.38	0.24	0.14
Annual	**0.0**	**43.1**	**n/a**	**15.73**	**n/a**

*National Climate Data Center 1981-2010 Monthly Normals

**M=missing data

	2014**
Last Frost (28 degrees)	M
First Frost (28 degrees)	M
Frost Free Period	n/a

Key to Table DI-2. 38I316K Field Evaluation of Woody Plant Materials – Dickinson, North Dakota

PLOT LOCATION = plot location of the plant material within the evaluation
ACCESSION NUMBER = any accession number, PI number or cultivar name assigned to the plant material
PLANT SYMBOL = plant symbol of the genus and species (asterisk indicates the symbol is not official)
GENUS/SPECIES = common name and scientific name of the plant material
ORIGIN/SOURCE = origin and/or source of the plant material
TRANS DATE = month and day the plant material was transplanted at the evaluation site
YR PLT = year the plant materials were transplanted at the evaluation site
YR REC = year of record
MATL PLTD = type of material planted, PLBR = bareroot, CONT = containerized
NO PLTS = number of plants planted in the plot
NO SRV = number of plants surviving
PCT SRV = percent of plants surviving
VI = plant vigor (1=excellent, 3=good, 5=fair, 7=poor, 9=very poor)
CAN COV (ft) = canopy cover measured in feet
PLT HT (ft) = plant height measured in feet

Table DI-2.
Project No.: 38I316K Field Evaluation of Woody Plant Materials, Dickinson, North Dakota
Year of Record: 2014

PLOT LOCATION	ACCESSION NUMBER	PLANT SYMBOL	GENUS/SPECIES ORIGIN/SOURCE	TRANS DATE	YR PLT	YR REC	MATL PLTD	NO PLTS	NO SRV	PCT SRV	VI	CAN COV (ft)	PLT HT (ft)	REMARKS
IA/02/1-5	9082885	POTR5	aspen	11-May	04	04		5	5	100	4	0.8	1.9	browsed off, regrowing
			Populus tremuloides			05			3	60	3	2.1	3.5	
			NDFS Nursery, Towner, ND			06			5	100	4	2.0	2.7	
						08			3	60	4	2.0	2.5	
						10			3	60	4	3.3	3.9	
						13			3	60	3	8.3	10.3	
1A/02/6-10	9082619	FRPE	green ash	16-May	02	02	CONT	5	5	100	5	0.5	0.8	3,5 browsed by rabbit
			Fraxinus pennsylvanica			03			3	60	4	0.5	1.3	
			Jordan, MT			04			5	100	3	0.9	2.4	
			Valley Nursery, Helena, MT			06			5	100	3	2.1	4.3	
						08			5	100	4	2.7	5.6	
						12			5	100	2	7.8	12.9	
IA/03/1-5	'Manitou'	POPUL	poplar	9-May	90	90	PLBR	5	5	100	2	1.7	3.0	
	9058874		*Populus*			91			5	100	4	2.5	4.1	
	14392		USDA, ARS, Mandan, ND			92			5	100	4	1.6	3.2	
			Lincoln-Oakes Nursery, Bismarck, ND			94			5	100	2	9.5	16.2	
						96			5	100	3	11.7	24.6	anthracnose on leaves,
						99			5	100	3	12.2	35.2	leaves dropping on all trees
						04			5	100	5	11.8	24.6	
						09								mostly all dead
						10			2	40	3	15.5	27.4	
						14			2	40	8	16.0	28.0	
IA/04/1-5	9030611	POAL7	white poplar	15-May	92	92	CONT(P)	5	4	80	4	1.6	1.6	
	ND-3796		*Populus alba*			93			5	100	2	3.8	3.7	
			Turner Co., SD			94			4	80	3	6.3	5.9	
			USDA, NRCS, PMC, Bismarck, ND			96			4	80	6	8.7	7.7	dieback on all trees
						98			4	80	3	14.4	13.3	
						02			4	80	7	17.0	13.5	dieback from freezing on all
						06			4	80		16.0	15.2	
						12			4	80	3	16.1	21.6	

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PLOT LOCATION	ACCESSION NUMBER	PLANT SYMBOL	GENUS/SPECIES ORIGIN/SOURCE	TRANS DATE	YR PLT	YR REC	MATL PLTD	NO PLTS	NO SRV	PCT SRV	VI	CAN COV (ft)	PLT HT (ft)	REMARKS
IA/05/1-5	9082640	QUGA	Gambel oak	13-May	99	99	CONT	5	5	100	3	0.8	1.6	
			Quercus gambelii			00			3	60	4	0.9	1.2	
			Lincoln-Oakes Nursery, Bismarck, ND			01			3	60	3	2.1	2.3	
						03			3	60	3	0.9	1.9	browsed
						05			3	60	5	1.2	2.0	
						08			2	40	4	1.8	3.4	
						13			2	40	4	3.3	4.9	
IA/05/6-10	9069090	POTR5	quaking aspen	15-May	93	93	PLBR	5	4	80	5	0.8	1.7	
			Populus tremuloides			94			5	100	3	1.7	4.1	
			Lee Nursery, Fertile, MN			95			5	100	3	3.4	6.2	
						97			5	100	2	5.8	9.9	
						99			5	100	3	8.8	17.3	very colorful fall foliage
						02			5	100	1	12.5	22.6	almost white bark on 5
						07			5	100	2	15.5	25.8	slight dieback 2,5
						12			3	60	4	12.5	24.4	
IA/6/1-5	9087732	QUMA2	bur oak	6-May	09	09	PLBR	5	5	100	4	1.6	2.5	
			Quercus macrocarpa			10			4	80	5	1.3	2.1	
			USDA, NRCS, PMC, Bridger, MT			12			3	60	6	1.1	1.1	tops dead, basal resprouts
						13			3	60	3.3	1.5	2.2	dieback 3
IA/06/6-10	'Assiniboine'	POPUL	hybrid poplar	10-May	93	93	PLBR	5	5	100	4	0.5	1.8	
	9063147		*Populus*			94			5	100	3	3.7	6.1	
			PFRA, Indianhead, Saskatchewan, Canada			95			5	100	3	7.9	11.4	
						97			5	100	4	11.7	17.1	
						99			5	100	3	11.5	27.8	
						02			5	100	3	14.0	31.4	leaf disease on all
						07			5	100	5	11.3	25.2	dead branches on 1
						12			3	60	4	16.8	31.8	dead branches 2,5

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PLOT LOCATION	ACCESSION NUMBER	PLANT SYMBOL	GENUS/SPECIES ORIGIN/SOURCE	TRANS DATE	YR PLT	YR REC	MATL PLTD	NO PLTS	NO SRV	PCT SRV	VI	CAN COV (ft)	PLT HT (ft)	REMARKS
IA/07/1-5	9063141	PODE3	eastern cottonwood	10-May	93	93	PLBR	5	5	100	3	1.6	3.4	
			Populus deltoides			94			5	100	2	5.6	9.0	
			Lincoln-Oakes Nursery, Bismarck, ND			95			5	100	3	8.1	13.7	severe leaf rust
						97			5	100	2	15.7	22.4	
						99			5	100	2	13.5	31.8	
						02			5	100	2	18.0	37.4	2,3,4,5 have some leaf disease
						07			5	100	4	17.5	39.0	
						12			5	100	4	21.9	38.8	all multi-stemmed; dead tops 3,4
IA/08/1-5	'Hunter Germplasm'	PIPOS	ponderosa pine	17-May	05	05		5	5	100	4	0.9	1.3	
			Pinus ponderosa var. *scopulorum*			06			5	100	3	1.1	1.8	
	9081843		USDA, NRCS, PMC, Bridger, MT			07			5	100	4	1.1	1.8	
						09			4	80	3	2.1	2.7	
						12			4	80	2	3.7	5.9	deer rub 4
						14			4	80	4	5.9	9.0	
1A/08/6-10	'Bridger-Select'	JUSC2	Rocky Mountain juniper	17-May	05	05		5	5	100	5	0.7	1.0	one mowed off
			Juniperus scopulorum			06			5	100	4	1.0	1.6	
	9078631		USDA, NRCS, PMC, Bridger, MT			07			4	80	3	1.1	1.9	
						09			4	80		2.1	2.8	
						12			4	80	2	4.4	5.5	
						14			4	80	4	5.1	7.5	
IA/09/1-5	9069164	PISY	Scots pine	4-May	98	98	CONT	5	4	80	4	0.8	1.2	
			Pinus sylvestris var. *mongolica*			99			4	80	4	1.0	1.5	
			Heilongjiang Province, China			00			4	80	3	1.6	2.0	
			USDA, NRCS, PMC, Bismarck, ND			02			4	80	3	3.0	4.0	
						04			5	100	3	4.2	5.7	
						07			5	100	3	7.5	10.4	
						12			5	100	1	12.3	18.7	

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PLOT LOCATION	ACCESSION NUMBER	PLANT SYMBOL	GENUS/SPECIES ORIGIN/SOURCE	TRANS DATE	YR PLT	YR REC	MATL PLTD	NO PLTS	NO SRV	PCT SRV	VI	CAN COV (ft)	PLT HT (ft)	REMARKS
IA/09/6-10	9069168	LASI3	Siberian larch	4-May	98	98	CONT	5	4	80	4	0.6	1.3	
			Larix sibirica			99			5	100	3	1.0	1.8	
			Altai region, Russia			00			1	20	2	1.4	2.8	
			USDA, NRCS, PMC, Bismarck, ND			02			1	20	1	3.0	6.5	
						04			1	20	1	4.5	9.0	
						07			1	20	2	8.0	10.2	
						12			1	20	1	14.0	20.0	
IA/10/6-10	9082889	PIMU80	Mugo pine	11-May	04	04		5	1	20	3	0.8	1.3	
			Pinus mugo			05			2	40	6	0.8	0.7	
			Big Sioux Nursery, Watertown SD			06			3	60	4	1.2	1.0	
						08			2	40	4	1.9	1.5	
						10			2	40	4	3.1	2.2	
						13			2	40	2	5.0	5.0	
IB/01/1-10	ND-1729	LASI3	Siberian larch	16-May	78	78	PLBR	10	9	90	3	0.7	2.0	
	9005979		*Larix sibirica*			79			10	100		0.7	1.4	
			NDFS State Nursery, Towner, ND			80			10	100	4	1.1	1.8	
						82			8	80	8	1.0	1.5	
						83			6	60	7	1.1	2.4	1 mowed off, moderate rodent
						84			6	60	4	1.3	3.0	damage
						87			6	60	6	3.0	6.5	
						92			5	50	4	7.7	11.4	
						97			5	50	2	13.1	17.9	
						02			5	50	2	17.5	25.8	
						07			5	50	4	16.0	26.2	
						12			5	50	3	20.1	28.7	

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PLOT LOCATION	ACCESSION NUMBER	PLANT SYMBOL	GENUS/SPECIES ORIGIN/SOURCE	TRANS DATE	YR PLT	YR REC	MATL PLTD	NO PLTS	NO SRV	PCT SRV	VI	CAN COV (ft)	PLT HT (ft)	REMARKS
IB/02/1-10	SL-383-T	LASI3	Siberian larch	17-May	78	78	PLBR	10	10	100	3	0.6	2.2	
	Pallet No.		*Larix sibirica*			79			10	100		0.8	1.6	
	2392		Denbigh Exp. Forest			80			10	100	4	1.4	2.0	
	9005976		USDA, FS, Shelterbelt Lab.,			82			9	90	6	1.5	2.3	
			Bottineau, ND			83			9	90	6	2.0	3.9	1 mowed off, moderate rodent
						84			8	80	2	2.6	5.6	damage
						87			8	80	2	5.9	10.0	
						92			8	80	8	9.9	16.4	
						97			8	80	1	16.2	23.3	
						02			8	80	2	19.0	32.0	
						07			8	80	3	17.0	31.3	
						12			8	80	8	22.1	32.4	
IB/03/1-10	ND-1765	LASI3	Siberian larch	17-May	78	78	PLBR	10	10	100	3	0.6	1.4	
	9005980		*Larix sibirica*			79			10	100		1.1	1.6	
			USDA, FS, Shelterbelt Lab.,			80			10	100	4	1.8	2.7	
			Bottineau, ND			82			10	100	5	2.1	4.0	
						83			10	100	5	2.6	4.9	moderate rodent damage, best
						84			10	100	4	3.6	6.1	accession of larch
						87			9	90	2	7.0	11.0	
						92			9	90	2	10.4	17.5	
						97			9	90	2	15.6	24.2	
						02			9	90	2	22.0	32.0	
						07			9	90	3	21.0	30.2	dense canopy
						12			6	60		21.0	32.0	top dead 6

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IB/04/1-5	ND-1763	PIPO	ponderosa pine	16-May	78	78	CONT	5	5	100	1	0.5	1.7	
	9006043		*Pinus ponderosa*			79			4	80		0.5	1.1	
			757-5 Todd Co., SD			80			5	100	4	1.5	2.0	
			USDA, FS, Shelterbelt Lab.,			82			4	80	7	2.4	4.4	
			Bottineau, ND			83			4	80	5	2.9	3.6	animal damage
						84			4	80	3	3.8	4.9	
						87			3	60	3	5.2	7.5	
						92			3	60	3	9.1	14.0	
						97			3	60	1	15.4	21.7	
						02			3	60	3	21.0	33.0	
						07			3	60		21.0	34.2	
						12			3	60	1	25.9	36.4	
IB/04/6-10	ND-1565	PIAR	bristle cone pine	16-May	78	78	CONT	5	5	100	3	0.5	0.6	
	9006036		*Pinus aristata*			79			5	100		0.7	0.6	
			USDA, FS, Shelterbelt Lab.,			80			5	100	5	1.0	0.8	
			Bottineau, ND			82			1	20	5	2.1	3.0	
						83			4	80	8	1.0	0.8	mower damage on plt 3
						84			2	40	3	1.9	1.8	
						87			2	40	6	2.3	2.0	
						92			1	20	5	5.4	3.9	
						97			1	20	1	8.2	7.7	
						02			1	20	3	16.5	10.5	
						07			1	20	3	11.0	13.5	
						12			1	20	2	15.0	16.3	
IB/05/1-5	9057413	PIPO	ponderosa pine	11-May	88	88	CONT	5	2	40	4	0.3	1.1	
			Pinus ponderosa			89			2	40	4	0.7	1.4	
			Glendive, MT			90			4	80	4	0.8	1.5	
			NDFS			92			4	80	4	1.2	2.2	
						94			4	80	4	3.0	4.2	
						97			4	80	2	7.2	9.3	
						02			4	80	2	12.5	20.9	
						07			4	80	2	14.3	26.9	
						12			4	80	1	21.4	32.0	

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PLOT LOCATION	ACCESSION NUMBER	PLANT SYMBOL	GENUS/SPECIES ORIGIN/SOURCE	TRANS DATE	YR PLT	YR REC	MATL PLTD	NO PLTS	NO SRV	PCT SRV	VI	CAN COV (ft)	PLT HT (ft)	REMARKS
IB/05/6-10	9069169	PISI3	Siberian pine	14-May	03	03		5	5	100				
			Pinus sibirica			04			5	100	3	0.6	0.8	
			Altai			05			5	100	4	1.0	0.9	
			USDA, NRCS, PMC, Bismarck, ND			07			5	100	3	0.8	1.0	
						09			2	40	4	1.5	1.1	
						12			2	40		2.3	2.9	
IB/06/1-5	9069172	PISY	Scots pine	6-May	97	97	CONT	5	5	100	2	0.5	1.2	
			Pinus sylvestris			98			4	80	3	1.2	1.7	
			Altai region, Russia			99			5	100	1	1.3	2.6	
			USDA, NRCS, PMC, Bismarck, ND			01			5	100	2	2.5	4.9	
						03			5	100	3	4.2	7.7	
						06			5	100	3	6.4	12.4	
						12			4	80	3	9.9	22.5	
IB/06/6-10	9092231	PICOL	lodgepole pine	6-May	09	09		5	5	100	4	0.5	1.0	
	14070 (ARS)		*Pinus contorta* var. *latifolia*			10			5	100	3	1.2	1.6	
			Routt National Forest, Salida, CO			12			5	100	3	2.2	3.1	
			Towner State Nursery, Towner, ND											
IB/7/1-5	9094406	ULAM	American elm	10-May	12	12		5	5	100	5	0.3	1.6	
	'Princeton'		*Ulmus americana*			13			4	80	5		1.4	wormwood/white poplar comp
			Schumacher's Nursery, Heron Lake, MN											
IB/07/6-10	ND-3803	POAL7	white poplar	24-May	94	94	CONT	5	5	100	3	2.0	3.1	
	9030612		*Populus alba*			95			4	80	2	6.2	6.5	
			USDA, PMC, Bismarck, ND			96			4	80	5	4.4	4.4	
						98			4	80	3	11.2	11.1	
						00			4	80	2	14.0	17.3	
						03			4	80	2	19.4	21.1	
						08			4	80	3	31.0	27.3	suckering
						13			4	80	2	33.0	43.5	

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IB/08/1-5	9091967	PRPE2	pin cherry	6-May	09	09		5	5	100	3	0.6	1.9	
			Prunus pensylvanica			10			4	80	5	0.9	1.5	
			Upper Red Lake, MN			12			5	60	5	0.5	1.5	wh poplar competition 3-5
			Big Sioux Nursery, Watertown, SD			13			5	60	5	1.0	2.3	wh poplar competition 1
IB/08/6-10	Riverview Germplasm	RIAM2	American black currant	9-May	07	07		5	0	0				
	9082687		*Ribes americanum*			08			2	40	6	0.4	1.8	
			northeastern South Dakota			09			4	80	3	2.0	2.1	
			Big Sioux Nursery, Watertown, SD			12			5	100	4	2.7	3.0	20% leaves dead along mid ribs
						13			5	100	4	2.4	2.1	wh poplar competition 1,2,4
IB/09/1-5	9063148	PHSA80	corktree	4-May	95	95	CONT	5	5	100	4	0.7	1.3	
			Phellodendron sachalinense			96			4	80	3	1.7	2.2	
			Clay Co., MN			97			4	80	3	2.6	2.9	
						99			3	60	2	5.2	5.7	some hail damage
						01			3	60	3	10.8	8.3	
						05			3	60	2	14.8	11.3	
						09			3	60	3	14.2	13.3	
						14			3	60	3	19.6	16.9	
IB/09/6-10	ND-21	VILE	nannyberry	7-May	86	86	PLBR	5	5	100	3	0.5	1.5	
	9034900		*Viburnum lentago*			87			5	100	3	0.7	1.9	
			USDA, ARS, Mandan, ND			88			5	100	3	1.5	2.7	
			USDA, NRCS, PMC, Bismarck, ND			90			5	100	3	2.7	3.8	
						92			5	100	3	4.2	4.7	
						95			5	100	2	6.5	7.4	fruit on 1,2,4,5
						00			5	100	5	9.7	10.3	
						05			5	100	4	12.0	11.2	leaves quite dry on 1
						10			5	100	2	11.0	11.2	

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IB/10/1-5	9069081	TICO2	littleleaf linden	10-May	93	93	CONT(P)	5	5	100	5	0.7	1.3	weedy
			Tilia cordata			94			5	100	4	0.6	1.2	
			Lee Nursery, Fertile, MN			95			5	100	4	2.1	2.8	
						97			5	100	4	4.0	4.0	
						99			5	100	3	6.9	7.4	
						02			5	100	3	10.5	11.6	
						07			5	100	4	13.0	16.0	
						12			5	100	3	19.4	20.4	
IB/10/6-10	9063126	ULDAJ	Japanese elm	15-May	92	92	CONT(P)	5	3	60	4	1.7	1.7	
			Ulmus davidiana var. *japonica*			94			3	60	3	4.2	4.5	
			Manchuria			96			5	100	4	5.9	6.3	5 is sucker
			PFRA, Indianhead, Saskatchewan, Canada			98			4	80	5	12.0	10.7	dieback on 2,3,4
						01			4	80	4	14.8	11.7	all have dead branches
						06			4	80	4	16.0	12.9	dieback on 3,4; severe on 3
						12			3	60	3	20.1	19.9	
II/01/1-10	ND-313	LOTA	red tatarian honeysuckle	17-May	78	78	PLBR	10	9	90	1	1.5	1.6	
	9005996		*Lonicera tatarica sibirica*			79			9	90		2.0	2.4	
	PI-477999		USDA, ARS, Cheyenne, WY			80			10	100	3	3.2	2.4	
			USDA, NRCS, PMC, Bismarck, ND			82			10	100	4	5.3	4.5	
						83			10	100	3	5.9	5.4	good fruit
						84			10	100	4	7.4	5.5	moderate-severe insect
						87			10	100	3	5.6	6.7	defoliation, honeysuckle aphid
						92			10	100	5	6.8	7.3	
						97			10	100	5	15.3	9.0	
						02			10	100	3	15.5	11.6	
						07			10	100	7	14.0	10.5	
						12			8	80	6	5.3	10.0	

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II/01/11-20	ND-1730	LOTA	red tatarian honeysuckle	17-May	78	78	PLBR	10	10	100	1	1.6	1.7	
	9005994		*Lonicera tatarica sibirica*			79			10	100		2.2	2.8	
			Lincoln-Oakes Nursery, Bismarck, ND			80			10	100	1	3.4	3.0	
						82			10	100	4	5.9	5.2	
						83			10	100	3	6.7	6.5	good vigor
						84			10	100	5	7.7	6.6	slight insect defoliation
						87			10	100	3	6.5	7.2	good fruit production,
						92			9	90	6	6.4	7.1	snow damage, aphid damage
						97			9	90	5	15.3	8.2	
						02			10	100	3	15.5	11.5	
						07			10	100	8	11.5	9.5	
						12			9	90	4	11.5	10.0	
II/02/1-5	9082684	RHGL	smooth sumac	14-May	03	03		5						weedy, poor survival
			Rhus glabra			04			5	100	3	3.0	2.6	
			Lincoln-Oakes Nursery, Bismarck, ND			05			5	100	4	4.8	3.6	
						07			5	100	2	6.0	6.0	
						09			5	100	2	7.0	6.8	
						12			5	100	2	8.8	8.0	
ll/02/6-10	9008183	PRVI	chokecherry	17-May	05	05		5	4	100	4	1.0	2.3	
			Prunus virginiana			06			4	100	4	2.2	3.2	
			Sheridan County, ND			07			4	100	3	2.4	3.4	
			Lincoln-Oakes Nursery, Bismarck, ND			09			4	80	3	3.6	5.0	
						12			5	100	3	5.6	7.6	Schubert 5
						14			5	100	3	7.1	9.3	

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II/03/1-10	ND-26	LONIC	honeysuckle	2-May	79	79	PLBR	10	10	100		1.1	1.4	
	9011852		*Lonicera*			80			10	100	5	2.0	1.7	
			USDA, ARS, Mandan, ND			81			10	100		2.6	2.9	
						83			10	100	4	4.5	4.8	leaf spot
						84			10	100	4	4.9	5.4	witches broom on plts 3,5,8
						88			10	100	4	7.5	7.0	moderate insect defoliation,
						93			10	100	5	10.5	9.0	grasshoppers, aphid damage
						98			10	100	4	15.4	10.5	aphid damage on 3
						03			10	100	4	21.0	11.8	
						08			10	100	5	18.0	11.0	
II/03/11-15	ND-452	LOXY	honeysuckle	2-May	79	79	PLBR	5	5	100		1.2	1.3	
	9019978		*Lonicera xylosteum mollis*			80			5	100	3	2.3	1.5	
			USDA, ARS, Cheyenne, WY			81			5	100		3.2	2.9	
			USDA, NRCS, PMC, Bismarck, ND			83			5	100	4	5.5	5.5	witches broom on 1,2,3
						84			5	100	3	6.5	5.5	slight leaf spot, leaf
						88			5	100	5	7.5	6.7	blight, aphid damage
						93			5	100	6	9.3	7.6	
						98			5	100	6	11.5	8.4	severe aphid damage on 1,2
						08			3	60	5	11.5	9.0	
II/03/16-20	ND-170	COIN16	cotoneaster	9-May	90	90	CONT	5						
	9005728		*Cotoneaster integerrimus*			91			4	80	6	0.8	1.5	
			USDA, NRCS, PMC, Bismarck, ND			92			4	80	6	1.5	1.4	
						94			4	80	4	4.1	3.0	
						96			4	80	4	5.5	3.5	
						99			4	80	4	5.1	3.5	
						04			4	80	5	6.5	4.5	fireblight on 2, 3
						09			4	80	3	5.5	4.5	
						14			5	100	4	5.9	4.6	

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II/04/1-5	9082711	EUBU6	winterberry euonymus	16-May	02	02	PLBR	5	4	80	4	1.0	1.7	
			Euonymus bungeanus			03			4	80	5	0.9	2.0	
			Lincoln-Oakes Nursery, Bismarck, ND			04			4	80	5	0.4	0.9	cut off #4
						06			4	80	5	0.3	1.4	2 chewed off, 3 heavily browsed
						08			3	60	3	1.8	2.4	
						12			1	20	4	1.5	4.8	chewed off; resprout
II/04/11-20	'Regal'	PRTE5	Russian almond	8-May	80	80	PLBR	10	10	100	5	0.8	2.2	
	ND-283		*Prunus tenella*			81			7	70		0.9	1.4	
	9006079		ND Game & Fish Dept.			82			10	100	4	1.8	2.3	
	PI-540442		USDA, NRCS, PMC, Bismarck, ND			83			8	80	4	3.9	3.5	few pests
						84			10	100	4	3.8	3.7	
						86			9	90	4	5.2	4.5	
						88			9	90	3	6.0	4.7	
						89			9	90	4	4.2	4.8	
						94			9	90	4	6.6	4.3	
						99			5		3	13.1	6.6	
						04			10	100	3	13.0	7.0	
						09			10	100	3	16.0	5.5	good seed crop
						14			10	100	5	14.0	6.0	contaminants
II/05/1-10	ND-11	LOMA6	amur honeysuckle	7-May	81	81	CONT	10	10	100		0.7	0.6	
	9005993		*Lonicera maackii*			82			10	100	4	1.4	1.4	
	PI-477998		Res. Sta., Morden, MB, Canada			83			6	60	6	1.6	1.8	slight insect
						84			10	100	4	2.1	1.8	defoliation (grasshoppers)
						86			10	100	4	4.2	4.6	
						87			10	100	3	8.5	5.6	
						88			10	100	4	7.4	5.6	
						90			10	100	4	5.7	5.7	
						95			10	100	4	7.1	8.5	
						00			10	100	4	8.4	10.0	
						05			10	100	2	16.1	12.2	
						10			10	100	3	16.0	13.0	

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II/05/11-20	'Centennial'	COIN16	cotoneaster	8-May	85	85	PLBR	10						no data
	ND-177		*Cotoneaster integerrimus*			86			8	80	4	2.3	2.2	
	9005729		Lincoln-Oakes Nursery, Bismarck, ND			87			7	70	3	4.0	3.3	
	PI-113095					88			10	100	4	3.2	3.0	
						89			8	80	4	4.5	3.5	
						91			7	70	5	5.3	4.3	
						94			7	70	4	7.5	7.6	
						99			7	70	4	12.5	10.2	
						04			7	70	5	12.0	10.5	fireblight on all
						09			7	70	3	12.0	10.5	
						14			7	70	7	15.0	14.0	fireblight on all
II/06/1-5	9057406	RORU	rugosa rose	16-May	02	02	CONT	5	5	100	5	1.0	1.4	
			Rosa rugosa			03			3	60	3	0.8	1.0	
			Lincoln-Oakes Nursery, Bismarck, ND			04			5	100	3	1.8	1.6	
						06			5	100	4	3.2	2.4	
						08			5	100	5	2.1	1.6	
						12			5	100	4	3.7	3.0	50% brown leaves & dead cones
II/06/11-15	9082638	SANIC5	western blue elderberry	13-May	99	99	CONT	5						
			Sambucus nigra ssp. *caerulea*			00			5	100	4	1.5	2.9	
			Lincoln-Oakes Nursery, Bismarck, ND			01			5	100	3	4.9	5.5	
						03			5	100	2	7.0	6.0	
						05			5	100	4	12.7	9.0	
						08			5	100	5	9.0	9.2	
						13			5	100	5	8.4	10.0	
II/07/1-5	9076737	PRSE2	black cherry	6-May	97	97	PLBR	5	4	80	3	1.1	1.7	
			Prunus serotina			98			5	100	4	2.8	3.0	
			Apple Valley FEP, ND			00			5	100	3	6.6	7.9	
			Lincoln-Oakes Nursery, Bismarck, ND			03			5	100	2	12.4	12.5	
						06			5	100	2	16.0	15.0	
						12			5	100	2	14.8	18.7	

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II/07/6-10	'McKenzie'	PHME13	black chokeberry	23-May	00	00	PLBR	5	5	100	3	0.9	1.7	
	323957		*Photinia melanocarpa*			01			5	100	4	1.8	1.7	
			Lincoln-Oakes Nursery, Bismarck, ND			02			5	100	3	0.9	1.7	
						04			5	100	3	4.3	3.6	
						06			5	100	2	5.4	4.6	
						09			5	100	3	4.8	5.5	
						14			5	100	4	6.3	6.9	
II/08/1-5	9063142	PRUNU	Japanese cherry	10-May	93	93	PLBR	5	5	100	4	1.2	2.0	
			Prunus			94			5	100	4	1.7	2.6	
			Bottineau FEP, ND			95			4	80	4	2.6	3.0	
			Lincoln-Oakes Nursery, Bismarck, ND			97			3	60	6	1.6	2.3	
						99			2	40	4	3.0	3.3	
						02			2	40	5	5.1	3.0	1,4 have some dieback
						07			2	40	4	4.8	4.9	
						12			2	40	3	5.5	4.5	
II/08/6-10	9082713	PRPEP2	Siberian peach	16-May	02	02	PLBR	5	5	100	2	1.6	2.7	
			Prunus persica var. *persica*			03			5	100	4	4.1	4.0	
			Lincoln-Oakes Nursery, Bismarck, ND			04			4	80	2	6.1	5.8	
						06			4	80	4	7.8	6.8	
						08			4	80	4	6.9	7.7	
						12			4	80	6	6.6	6.4	some dead limbs/basal resprout
II/09/1-10	'Homestead'	CRAN6	Arnold hawthorn	9-May	84	84	CONT	10	10	100	4	0.7	0.3	
	ND-20		*Crataegus X anomala*			86			10	100	4	1.7	2.7	
	9005731		USDA, NRCS, PMC, Bismarck, ND			88			10	100	3	3.8	4.8	
	PI-503530					90			10	100	4	4.0	6.0	
						93			9	90	3	6.2	8.9	
						98			9	90	2	13.1	13.0	
						03			9	90	2	18.0	15.4	
						08			9	90	4	18.0	16.2	leaves dried up due to drought
						13					2	25.4	17.2	

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II/10/2-6	ND-3742	JUCO6	common juniper	4-May	06	06	CONT	5	5	100	4	1.6	1.0	
	9019593		*Juniperus communis*			07			4	80	5	0.8	0.7	
						08			3	60	3	1.1	0.9	
						10			4	80	4	2.5	1.3	
						12			4	80	1	4.2	1.8	
II/10/6-10	9057438	HAHA8	Siberian salt tree	11-May	94	94	CONT	5	1	20	3	0.3	1.1	
			Halimodendron halidendron			95			4	80	4	0.6	1.3	
			PFRA, Indianhead, Saskatchewan, Canada			96			4	80	4	0.8	1.6	soil shallow to bedrock
						98			5	60	5	0.9	2.0	
						03			1	20	2	1.8	3.5	many pods left from 2002
						08			1	20	6	3.0	1.8	
						13			1	20	5	1.5	2.5	
II/10/11-15	9082712	CESC	bittersweet	16-May	02	02	PLBR	5	4	80	4	0.4	1.1	
			Celastrus scandens			03			5	100	4	0.7	1.7	
			Lincoln-Oakes Nursery, Bismarck, ND			04			5	100	3	0.7	1.4	
						06			5	100	3	2.0	2.1	
						08			5	100	5	1.5	1.5	
						12			5	100	1	5.5	3.4	
III/01/1-5	'Midwest'	MAMA37	Manchurian crabapple	17-May	78	78	PLBR	5	3	60	2	0.5	2.0	
	9006003		*Malus mandshurica*			79			5	100		0.9	2.1	
	PI-478000		Echo Manchuria/Res. Sta.			80			5	100	3	1.9	2.8	
			Morden, MB, Canada			82			5	100	3	4.7	5.5	
			USDA, NRCS, PMC, Bismarck, ND			83			5	100	2	6.0	6.9	fall webworm on 1, few
						84			5	100	4	7.7	8.5	pests, good vigor,
						87			5	100	3	9.4	11.4	snow damage on 1,2,3
						92			2	40	8	6.0	7.3	
						97			2	40	3	13.8	13.9	
						02			2	40	4	15.5	14.6	
						07			2	40	8	12.0	12.9	many dead branches
						12			2	40	5	8.8	11.7	

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III/01/6-10	'Red Splendor'	MABA	flowering crabapple	17-May	78	78	PLBR	5	5	100	2	1.6	2.2	
			Malus X			79			5	100		2.5	3.8	
	9006004		Lee Nursery, Fertile, MN			80			5	100	2	3.5	4.7	
						82			5	100	3	5.9	8.4	
						83			5	100	3	7.0	9.1	good fruit production, few pests
						84			5	100	3	8.6	10.9	snow damage 1,2; webworm 3,5
						87			5	100	2	10.3	12.2	
						92			5	100	6	9.3	11.2	
						97			5	100	4	13.8	14.0	
						02			5	100	4	14.5	15.6	
						07			5	100	6	13.0	14.1	
						12			3	60	7	11.5	13.3	only a few basal sprouts on 2
III/02/1-5	ND-1731	MABA	Siberian crabapple	17-May	78	78	PLBR	5	4	80	2	1.9	2.2	
	9006001		*Malus baccata*			79			5	100		2.8	3.1	
			Lincoln-Oakes Nursery,			80			5	100	3	4.1	4.1	
			Bismarck, ND			82			5	100	3	5.8	8.2	
						83			5	100	2	7.5	10.5	good growth & vigor,
						84			5	100	2	10.1	10.8	few pests, fall webworm
						87			5	100	3	10.6	13.9	on 1,4,5
						92			5	100	6	9.2	13.7	
						97			5	100	6	13.7	14.4	
						02			5	100	5	15.5	16.8	
						07			4	80	6	12.5	16.5	
						12			2	40	8	9.8	14.1	only 1 limb alive on 1

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III/02/6-10	'McDermand'	PYUS2	Ussurian pear	17-May	78	78	PLBR	5	5	100	6	0.9	2.5	
	ND-14		*Pyrus ussuriensis*			79			5	100		1.8	3.6	
	9006095		Harbin, Manchuria/Res. Sta.			80			5	100	1	3.0	4.6	
	PI-478004		Morden, MB, Canada			82			5	100	3	6.4	8.9	
			USDA, NRCS, PMC, Bismarck, ND			83			5	100	1	8.0	11.0	good growth & vigor
						84			5	100	2	9.3	12.4	
						87			5	100		12.4	15.8	snow damage on 4
						92			5	100	6	10.9	13.2	
						97			5	100	2	18.7	17.2	
						02			5	100	2	25.0	22.0	
						07			4	80	7	21.0	21.6	
						12			5	100	4	25.1	20.7	only 1 live limb on 4
III/03/1-5	'Freedom'	LOKO2	honeysuckle	9-May	90	90	PLBR	5	5	100	5	1.0	1.1	
	9057424		*Lonicera korolkowii*			91			5	100	4	1.4	1.6	
			Univ. of MN			92			5	100	3	3.3	3.1	
						94			5	100	3	6.6	6.1	
						96			5	100	3	8.5	7.8	minor dieback
						99			5	100	2	14.1	11.2	
						04			5	100	2	17.0	12.3	
						09			5	100	2	18.5	14.0	
						14			5	100	2	17.0	12.3	
III/03/6-10	9063143	LOTA	tatarian honeysuckle	10-May	93	93	PLBR	5	5	100	4	1.1	1.4	
			Lonicera tatarica			94			5	100	3	1.1	1.8	
			Iowa			95			5	100	4	2.2	2.8	
			Lincoln-Oakes Nursery, Bismarck, ND			97			5	100	3	3.5	4.2	
						99			5	100	4	4.3	6.1	
						02			5	100	3	6.5	6.5	
						07			5	100	5	6.0	9.3	
						12			5	100	5	9.5	9.5	

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III/03/11-15	Survivor Germplasm	AMFR	false indigo	6-May	87	87	PLBR	5	4	80		1.3	1.7	
			Amorpha fruticosa			88			5	100	5	2.8	2.1	
	9008041		USDA, NRCS, PMC, Aberdeen, ID			89			5	100	5	3.1	2.7	
						91			5	100	4	5.3	3.3	
						93			5	100	3	7.0	4.3	
						96			5	100	4	6.6	5.0	
						01			5	100	3	11.0	5.0	
						06								mostly dead, overgrown with other volunteers
						12			3	60	3	1.7	2.5	measured suckers
III/03/16-20	'Arnolds Red'	LOTA	red tatarian honeysuckle	10-May	93	93	PLBR	5	5	100	4	0.9	1.1	
	9069080		*Lonicera tatarica*			94			5	100	4	1.3	1.9	
			Lee Nursery, Fertile, MN			95			5	100	3	2.3	3.1	
						97			5	100	3	3.6	4.7	
						99			5	100	3	4.5	6.5	
						02			5	100	4	6.5	7.0	
						07			5	100	3	6.0	8.3	
						12			5	100	4	8.7	9.7	
III/04/1-5	'Konza'	RHAR4	aromatic sumac	6-May	87	87	PLBR	5	4	80		1.7	2.5	
	PI-477981		*Rhus aromatica*			88			4	80	3	3.4	3.1	
			USDA, NRCS, PMC, Manhattan, KS			89			4	80	4	3.8	3.7	
						91			4	80	3	5.7	4.4	
						93			4	80	2	9.6	6.3	
						96			4	80	4	9.2	6.7	
						01			4	80	1	16.0	8.0	solid thicket
						06			5	100	3	17.0	8.0	
						12			5	100	3	16.0	8.5	

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III/04/6-15	'Scarlet'	PRFR2	Mongolian cherry	9-May	90	90	PLBR	10	9	90	3	0.6	1.6	
	PI-478003		*Prunus fruticosa*			91			9	90	5	0.8	1.3	
			USDA, NRCS, PMC, Bismarck, ND			92			9	90	4	1.3	1.7	
						94			9	90	4	2.2	2.3	
						96			8	80	4	3.1	2.6	
						99			3	30	3	5.2	3.3	
						04								orignal row gone, suckers
						14			0	0				
III/04/16-20	'Legacy'	SYVI3	late lilac	11-May	88	88	PLBR	5	2	40	6	1.0	1.7	
	ND-83		*Syringa villosa*			89			2	40	6	0.4	1.1	
	9006228		USDA, NRCS, PMC, Bismarck, ND			90			5	100	5	0.7	1.1	
	PI-540443		Lincoln-Oakes Nursery, Bismarck, ND			92			3	60	4	1.9	1.9	
						94			3	60	3	4.2	4.4	
						97			3	60	3	8.1	6.9	
						02			3	60	2	11.0	10.0	
						07			3	60		11.0	9.8	
						12			3	60		9.0	11.7	
III/05/1-10	'Sakakawea'	SHAR	silver buffaloberry	9-May	90	90	PLBR	10	3	30	3	0.7	2.2	
	ND-10		*Shepherdia argentea*			91			4	40	4	0.5	1.9	
	PI-478005		USDA, NRCS, PMC, Bismarck, ND			92			8	80	4	0.9	1.7	
						94			8	80	3	3.0	3.7	
						96			8	80	2	5.9	7.0	
						99			8	80	3	8.4	11.3	
						04			8	80	3	13.0	11.8	
						14			8	80	6		12.6	severe honeysuckle infestation

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III/05/11-15	'Magenta'	MALUS	crabapple	15-May	92	92	PLBR	5	5	100	5	0.5	1.1	
	PI-514275		*Malus* sp.			93			4	80	3	1.6	3.0	
			USDA, NRCS, PMC, E. Lansing, MI			94			5	100	3	2.2	3.6	
						96			5	100	5	3.9	5.2	fireblight on 2,3,5; dieback on 1
						98			5	100	3	4.4	6.9	webworms on 4
						01			5	100	4	9.0	10.0	
						07			4	80	2	16.0	15.2	
						12			4	80	4	18.9	16.0	
III/06/1-5	9076726	ACGI	tatarian maple	13-May	96	96	PLBR	5	5	100	3	1.0	0.9	
			Acer ginnala			97			5	100	5	2.2	1.7	
			USDA, ARS, Mandan, ND			98			5	100	4	2.8	2.0	
						00			5	100	3	3.5	2.3	
						02			5	100	4	5.5	4.0	Canada thistle 1
						05			4	80		8.2	6.5	
						10			4	80	4	13.5	11.1	
lll/06/6-10	9091969	CAFR80	Russian peashrub	17-May	05	05		5	5	100	4	0.8	3.4	
			Caragana frutex			06			5	100	6	0.6	2.6	
			Big Sioux Nursery, Watertown, SD			07			5	100	5	0.9	2.6	
						09			5	100	4	0.9	2.9	
						12			5	100	6	1.4	3.8	some suckers 1,5
						14			4	80	7	2.3	4.1	all doing poorly
III/7/1-5	9082891	PHOP	common ninebark	12-May	10	10		5	5	100	5	0.6	1.6	
			Physocarpus opulifolius			12			5	100		2.8	3.2	lots of suckers
			Big Sioux Nursery, Watertown, SD			14			3	60	8	1.6	2.9	invaded by contaminants
III/07/6-10	9082653	RHTR	skunkbush sumac	14-May	03	03		5	5	100				
			Rhus trilobata			04			5	100	3	1.4	1.4	
			Harding Co., SD			05			4	80	4	2.0	1.5	
			USDA, NRCS, PMC, Bismarck, ND			06			5	100	3	3.4	2.0	
						07			5	100	3	3.6	2.4	
						09			4	80		7.0	3.3	
						12			5	100	3	8.8	3.5	hard to tell original from suckers

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III/08/1-5	'Prairie Red'	PRUNU	plum	8-May	85	85	PLBR	5						no data
	ND-1134		*Prunus*			86			5	100	8	0.5	1.3	
	9047203		Miller, SD			87			3	60	4	1.9	3.0	
			USDA, NRCS, PMC, Bismarck, ND			89			3	60	5	3.5	4.1	
						91			2	40	4	6.6	5.7	
						94			2	40	4	8.5	7.9	
						99			2	40	3	11.5	10.0	
						04			1	10	2	17.0	11.0	
						09			2	40	3	13.0	12.0	
						14			2	40	3	16.0	14.5	abundant fruit
III/08/6-10	ND-629	ACGI	amur maple	2-May	79	79	PLBR	5	5	100		1.0	1.5	
	9005645		*Acer ginnala*			80			0					
	PI-477992		Res. Sta., Morden, MB, Canada			81			4	80		1.3	1.9	
						83			4	80	3	6.0	6.0	
						84			4	80	4	9.9	7.5	
						88			4	80	4	13.0	10.8	
						93			3	60	5	13.1	12.0	
						98			3	60	3	18.4	17.4	
						03			3	60	3	24.5	16.4	
						08			3	60	5	32.0	16.2	
						13			3	60	2	26.0	19.0	
III/09/1-5	ND-1873	ACGI	amur maple	2-May	79	79	PLBR	5	5	100		1.6	2.2	
	9005648		*Acer ginnala*			80			5	100	3	2.8	3.0	
			Lincoln-Oakes Nursery, Bismarck, ND			81			5	100		4.2	4.3	
						83			5	100	2	7.2	7.4	good seed production
						84			5	100	3	10.0	8.8	
						88			5	100	4	13.2	11.7	
						93			5	100	4	10.0	9.9	
						98			5	100	3	16.1	13.4	
						03			5	100	3	19.9	14.6	
						08			5	100	4	18.0	14.5	
						13			5	100	3	20.3	15.6	

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III/09/6-10	ND-686	SYPE4	pekin lilac	2-May	79	79	PLBR	5	5	100		0.7	2.3	
	9006225		*Syringa pekinensis*			80			2	40	7	1.5	2.7	
	PI-478008		ND Game & Fish Dept.			81			2	40		1.5	2.8	
						83			3	60	5	3.3	3.8	
						84			5	100	5	3.1	2.9	
						88			3	60	4	8.3	8.3	
						93			3	60	4	10.1	9.9	
						98			3	60	3	15.5	14.2	
						03			3	60	3	18.5	16.5	
						08			3	60	3	21.0	16.5	
						13			3	60	1	22.3	20.8	
III/10/1-5	9069129	PRMA9	Amur chokecherry	11-May	94	94	PLBR	5	5	100	4	0.7	2.2	
			Prunus maackii			96			5	100	2	4.1	6.4	
			Big Sioux Nursery, Watertown, SD			98			5	100	3	7.7	10.7	
						00			5	100	4	9.1	12.7	
						03			5	100	4	11.2	12.5	
						08			5	100	5	10.0	12.8	
						13			5	100	5	14.3	15.5	
III/10/16-20	9094355	CODR	roughleaf dogwood	4-May	11	12			5	100	7	0.4	0.9	
			Cornus drummondii			13			5	100	3	0.8	1.3	
			Big Sioux Nursery, Watertown, SD											

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IV/01/1-5	SD-156	FRPE	green ash	17-May	78	78	PLBR	5	5	100	1	0.5	2.6	
	9005890		*Fraxinus pennsylvanica*			79			5	100		1.3	3.6	
			Deuel Co., SD			80			5	100	2	2.2	4.4	
						82			5	100	3	5.6	7.6	
						83			5	100	3	7.3	9.7	slight leaf scorch
						84			5	100	3	8.0	10.8	
						87			5	100	3	8.6	14.2	snow damage on 1
						92			5	100	4	8.9	15.8	
						97			5	100	4	13.5	18.3	
						02			5	100	6	17.0	25.5	
						07			5	100	5	18.8	25.8	
						12			5	100	3	12.2	27.7	
IV/01/6-10	ND-1734	FRPE	green ash	17-May	78	78	PLBR	5	5	100	2	0.4	2.1	
	9005891		*Fraxinus pennsylvanica*			79			5	100		1.0	3.1	
			Lincoln-Oakes Nursery, Bismarck, ND			80			5	100	4	1.9	3.7	
						82			5	100	4	4.7	7.3	
						83			5	100	4	5.7	8.8	competition from
						84			5	100	4	6.4	10.3	shelterbelt at east end
						87			5	100	4	7.1	13.8	
						92			5	100	5	8.3	14.0	
						97			5	100	4	12.8	20.3	
						07			5	100	5	15.0	24.8	
						12			5	100	4	15.0	25.5	

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IV/02/1-5	'Cardan'	FRPE	green ash	17-May	78	78	PLBR	5	5	100	2	0.3	2.3	
	MDN-12002		*Fraxinus pennsylvanica*			79			5	100		1.7	3.4	
	9005895		Wibaux Co., MT			80			5	100	3	3.0	5.1	
	PI-469226		USDA, ARS, Mandan, ND			82			5	100	3	7.5	10.1	
						83			5	100	2	8.4	11.4	good vigor
						84			5	100	3	9.7	13.8	
						87			5	100	3	9.5	18.1	
						92			5	100	3	10.9	22.5	
						97			5	100	3	15.1	25.1	
						07			5	100	3	20.0	33.3	
						12			5	100	5	16.7	32.5	20-50% dead limbs; native ash borer; lots of contaminants
IV/02/6-10	ND-1759	FRPE	green ash	17-May	78	78	PLBR	5	5	100	1	0.4	2.5	
	9005893		*Fraxinus pennsylvanica*			79			5	100		1.6	4.1	
			SD-156 X MDN-12002			80			5	100	3	3.1	5.2	
			USDA, NRCS, PMC, Bismarck, ND			82			5	100	4	5.8	8.1	
						83			5	100	3	7.9	10.7	competition from
						84			5	100	3	8.9	13.4	shelterbelt at north end
						87			5	100	3	9.0	15.8	
						92			5	100	3	10.2	19.0	
						97			5	100	2	15.6	25.1	
						02			5	100	3	17.0	29.4	
						07			5	100		20.0	30.2	
						12			5	100	4	18.1	30.2	

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IV/03/1-5	ND-647	FRNI	black ash	17-May	78	78	PLBR	5	5	100	1	0.1	0.9	
	9005887		*Fraxinus nigra*			79			5	100		0.4	1.9	
			Res. Sta., Morden, MB, Canada			80			5	100	6	1.2	2.7	
						82			5	100	4	4.1	8.0	
						83			5	100	4	4.8	10.5	heat stress
						84			5	100	4	4.2	11.4	leaf scorch
						87			5	100	3	5.6	18.4	sun scald
						92			5	100	7	5.6	15.2	
						97			5	100	5	12.3	19.3	
						02			5	100	3	14.0	26.8	
						07			5	100	5	14.5	29.1	
						12			2	40	6	9.0	25.5	
IV/03/6	ND-1432	AEGL	Ohio buckeye	17-May	78	78	PLBR	5	3	60	8	0.0	0.2	
	9005658		*Aesculus glabra*			79			3	60		0.1	0.5	
			Res. Sta., Morden, MB, Canada			80			3	60	9	0.5	0.4	
						82			1	20	6	1.5	2.1	
						83			1	20	6	1.6	2.3	
						84			1	20	6	3.3	3.3	
						87			1	20	6	6.2	5.4	
						92			1	20	5	7.9	7.2	
						97			1	20		12.8	10.5	
						02			1	20	4	12.5	15.5	
						07			1	20		14.5	15.5	
						12			1	20		17.0	23.8	
IV/03/7-11	9092162	PRUNU	pie cherry	10-May	12	12	CONT	5	1	20	7		2.5	shelters & water on all
			Prunus sp.			14			0	0				
			Harding County, SD											
			USDA, NRCS, PMC, Bismarck, ND											

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IV/04/1-5	ND-1879	GLTR	honeylocust	8-May	80	80	PLBR-	5	1	20	9	0.3	0.5	
	9011850		*Gleditsia triacanthos*			81	CONT		2	40		0.1	0.8	
	PI-503531		Woodward, OK			82			5	100	4	1.4	2.2	
			USDA, ARS, Mandan, ND			83			5	100	2	2.5	3.9	good vigor
						84			5	100	3	3.2	5.7	
						86			5	100	3	7.5	9.1	
						89			4	80	4	8.1	12.8	
						95			5	100	4	16.4	17.4	
						04			5	100	3	19.2	26.5	
						09			5	100	3	22.0	25.8	
						14			5	100	3	20.8	25.0	multi-stemmed 2
IV/04/6-10	909440	PRCE	dwarf cherry	10-May	12	12	PLBR	5	3	60	6		1.8	shelters & water on all
	'Carmine Jewel'		*Prunus cerasus*			13			5	100	3	1.6	2.0	tubes removed, pine comp on eas
			Big Sioux Nursery, Watertown, SD			14			5	100	6	1.0	1.7	stressed, few leaves remaining
IV/05/1-5	9063116	FRNI	black ash	11-May	94	94	CONT	5	5	100	4	0.3	1.2	
			Fraxinus nigra			95			5	100	4	0.9	1.4	
			Itasca State Park, MN			96			4	80	4	1.1	1.7	broken leader on 4
						98			4	80	3	2.0	3.6	
						00			4	80	4	3.2	6.5	
						03			3	60	4	5.3	10.2	
						08			3	60	4	4.8	12.6	
						13			3	60	2	6.7	13.5	
IV/06/6-10	9091968	GYDI	Kentucky coffeetree	4-May	11	12	PLBR	5	5	100	2	1.0	1.5	tip dieback, good limb growth
			Gymnocladus dioicus			13			5	100	2		1.8	
			Big Sioux Nursery, Watertown, SD											

Project No.: 38I316K Field Evaluation of Woody Plant Materials, Dickinson, North Dakota
Year of Record: 2014

PLOT LOCATION	ACCESSION NUMBER	PLANT SYMBOL	GENUS/SPECIES ORIGIN/SOURCE	TRANS DATE	YR PLT	YR REC	MATL PLTD	NO PLTS	NO SRV	PCT SRV	VI	CAN COV (ft)	PLT HT (ft)	REMARKS
IV/06/1-5	9063115	FRPE	green ash	11-May	94	94	CONT	5	5	100	3	0.7	1.7	
			Fraxinus pennsylvanica			95			5	100	3	1.5	3.3	
			Itasca State Park, MN			96			5	100	2	2.5	4.5	
						98			5	100	2	7.1	9.7	
						00			5	100	3	8.9	13.4	
						03			5	100		13.6	19.4	
						08			5	100	3	14.5	24.4	
						13			5	100	2	16.3	33.8	
IV/06/6-10	9076724	ELAN	Russian olive	13-May	96	96	PLBR	5	4	80	3	2.2	2.3	
			Elaeagnus angustifolia			97			4	80	3	3.3	3.4	
			USDA, ARS, Mandan, ND			98			4	80	3	5.4	5.5	
						00			4	80	4	7.9	8.4	
						02			4	80	5	11.0	9.5	needs a new stake
						05			4	80	4	11.7	12.5	
						10			4	80	3	15.5	14.8	
IV/07/1-5	Prairie Harvest Germplasm	CEOC	hackberry	3-May	10	10	CONT	5	5	100	6	0.3	1.0	all heavily browsed
			Celtis occidentalis			12			5	100	6	0.3	0.4	nearly tilled out, need shelters
	9034956		Polk County, MN			14			5	100	8	0.6	0.8	
IV/07/6-10	9069166	ELAN	Russian olive	13-May	96	96	CONT(S)	5	1	20	5	0.5	0.7	1-4 destroyed by cultivation
			Elaeagnus angustifolia			97			4	80	3	1.0	1.3	
			USDA, ARS, Mandan, ND			98			2	40	6	1.4	3.0	
						00			2	40	5	2.3	4.1	
						02			2	40	6	4.8	7.5	
						05			2	40	5	6.6	8.2	
						10			2	40	3	6.1	12.1	

Project No.: 38I316K Field Evaluation of Woody Plant Materials, Dickinson, North Dakota
Year of Record: 2014

PLOT LOCATION	ACCESSION NUMBER	PLANT SYMBOL	GENUS/SPECIES ORIGIN/SOURCE	TRANS DATE	YR PLT	YR REC	MATL PLTD	NO PLTS	NO SRV	PCT SRV	VI	CAN COV (ft)	PLT HT (ft)	REMARKS
IV/08/1-10	'Oahe'	CEOC	hackberry	8-May	80	80	PLBR	10	10	100		0.5	2.0	
	MDN-12003		*Celtis occidentalis*			81			9	90		0.1	0.5	
	9005725		USDA, ARS, Mandan, ND			82			8	80	6	1.3	1.6	
	PI-476982					83			8	80	6	1.9	3.0	
						84			7	70	4	2.9	4.6	
						86			4	40	3	9.2	10.3	
						89			5	50	4	8.7	11.7	
						95			5	50	4	14.3	19.0	
						99			5	50	5	14.0	20.3	
						04			5	50	4	16.8	25.4	
						09			5	50	5	17.5	23.5	
						14			5	50	4	21.1	26.0	
IV/09/1-10	SD-75	CEOC	hackberry	7-May	81	81	PLBR	10	10	100		0.1	1.2	
	9005713		*Celtis occidentalis*			82			7	70	6	0.9	1.4	
			Potter Co., SD			83			6	60	3	2.9	3.0	
						84			7	70	5	3.5	4.1	
						85			6	60	4	6.7	5.9	
						87			7	70	4	8.1	10.4	
						90			7	70	4	9.2	12.3	
						95			7	70	3	12.7	19.7	
						00			7	70	3	14.4	23.1	
						05			7	70	3	22.2	26.0	
						10			7	70	4	22.0	24.7	dead top 5,9
IV/10/1-5	9094356	PIME	Meyer's spruce	4-May	11	12	CONT	5	5	100	4	1.1	1.2	yellow needles on old growth
			Picea meyeri			13			3	100	3	1.2	1.5	
			Big Sioux Nursery, Watertown, SD											
W1/1/1-5	9094419	LOED	honeyberry (haskaps)	30-May	13	13	POTD	5	5	100	3	1.4	1.8	bindweed in holes
	'Berry Blue'		*Lonicera edulis*			14			5	100	1	1.6	2.2	
			Jeffries Nursery, Portage LaPrairie, MB											

Project No.: 38I316K Field Evaluation of Woody Plant Materials, Dickinson, North Dakota
Year of Record: 2014

PLOT LOCATION	ACCESSION NUMBER	PLANT SYMBOL	GENUS/SPECIES ORIGIN/SOURCE	TRANS DATE	YR PLT	YR REC	MATL PLTD	NO PLTS	NO SRV	PCT SRV	VI	CAN COV (ft)	PLT HT (ft)	REMARKS
W1/1/6-10	9094420	LOED	honeyberry (haskaps)	30-May	13	13	POTD	5	5	100	4	1.1	1.1	bindweed in holes
	'Cinderella'		*Lonicera edulis*			14			5	100	2	1.4	1.2	
			Jeffries Nursery, Portage LaPrairie, MB											
W1/1/11-15	9094418	COAM	American hazel	30-May	13	13	POTD	5	5	100	3	0.8	1.4	
			Corylus americana			14			5	100	2	1.5	2.2	
			northern MN source											
			Big Sioux Nursery, Watertown, SD											
W1/2/1-5	9094417	FRMA	Manchurian ash	30-May	13	13	POTD	5	5	100	2		3.3	in tubes
			Fraxinus mandshurica			14			5	100	1		5.4	
			China											
			Big Sioux Nursery, Watertown, SD											
W1/2/6-10	9094416	PLOC	sycamore	30-May	13	13	POTD	5	5	100	2		2.9	in tubes
			Platunus occidentalis			14			2	40	5		2.3	
			Lincoln-Oakes Nursery, Bismarck, ND											
W1/2/11-15	9094442	BEPO	gray birch	May	14	14	PLBR	5	5	100	1		6.4	tube is causing top breakage
			Betula populifolia											
			Wisconsin											
			Lawyer Nursery, Plains, MT											
W1/3/1-5	9094441	QUBI	swamp white oak	May	14	14	PLBR	5	5	100			2.6	
			Quercus bicolor											
			Illinois											
			Lawyer Nursery, Plains, MY											
W1/10/1-5	'Catskill'	PRPUD	sand cherry	May	14	14	PLBR	5	5	100	1	4.0	1.0	
	9051508		*Prunus pumila* var. *depressa*											
			Big Flats Plant Materials Center, Corning, NY											

OFF-CENTER EVALUATION PLANTINGS: TECHNICAL REPORT – 2014

Study 38I347K University of Minnesota, Sand Plain Experimental Research Farm, Becker, Minnesota.

Study Title: Field Evaluation of Woody Plant Materials.

Introduction: There is a need to evaluate the performance of shrub and tree species/cultivars for windbreaks, wildlife, and recreational plantings under diverse soil and climatic conditions. To meet this need, field evaluation planting sites representative of the major land resource areas are located in the three States served by the PMC. These sites provide planting locations under long-term land tenure for assemblies of trees and shrubs to be evaluated under uniform culture and management. New material can be added on an annual basis. Comparisons are made with previously released cultivars and area of adaptation determined.

Objective: The objective is to assemble and evaluate woody plant materials for conservation use. Superior cultivars will be selected and released for increase by commercial nurseries.

Cooperators: The USDA Natural Resources Conservation Service, Plant Materials Center, Bismarck, North Dakota, in cooperation with the University of Minnesota, Sand Plain Experimental Research Farm, Becker, Minnesota. The cooperative agreement expired August 9, 2010, and is in the review and renewal process.

Location: University of Minnesota, Sand Plain Experimental Research Farm, Becker, Minnesota. Legal Description: NW 1/4 SW 1/4 sec. 31, T. 34 N., R. 28 W.

Major Land Resource Area: This site is located in Major Land Resource Area 91, Wisconsin and Minnesota Sandy Outwash. About 90 percent of this area is in farms. The area is nearly level, with elevations averaging around 980 feet above sea level.

Soils: The soils at this site are a Hubbard-Mosford complex. Hubbard is formed from leached coarse and medium sand outwash. Drought and wind erosion are major management problems. Hubbard and Mosford soils are in Conservation Tree/Shrub Suitability Group 7.

Climate: The average annual precipitation for Sherburne County is 26 to 30 inches. The average annual temperature is 40 to 45 degrees F, with an average freeze-free period of 135 days. The plant hardiness zone for this site is 4a, with an average annual minimum temperature of -30 to -25 degrees F. Climatic data for 2013 at the nearest official weather station, Elk River, Minnesota, is shown in Table BE-1.

Methods and Materials

Assembly: Refer to Table BE-2 for a list of woody species planted from 1998 to 2014.

Planting Plan: The plots are not randomized or replicated but organized systematically for evaluation and demonstration purposes (Figure BE-1). The site is divided into four blocks (refer to Figure BE-2). Block 1 is planted to shrubs, Block 2 to medium trees, Block 3 to tall trees, and Block 4 to conifers. Each block is arranged into single row, non-replicated plots. Each plot contains 1 to 10 plants. Spacing is 20 feet between rows and 5 feet within row for shrubs and 10 feet within row for trees. Row length is 100 feet. Like species and standards of comparison are planted in adjacent plots whenever possible.

Site Preparation: A clean, firm planting site was prepared by roto-tilling.

Planting Method: All trees and shrubs were hand planted using approved forestry methods.

Planting Date: Refer to Table BE-2 for planting dates of woody species planted from 1998 to 2014.

Fertilization: No fertilizer has been applied to the planting area.

Weed Control: Mechanical weed control, rotary mowing between rows, and roto-tilling and hand hoeing within row.

Biological Control: None.

Irrigation: Trees are often hand watered at time of planting.

Crop Residue Management: On May 20, 2003, Block I (shrubs) was seeded between rows to a cover of 50 percent Bad River blue grama and 50 percent Pierre sideoats grama. In 2008, fescue was seeded between rows in Blocks III and IV. Blue grama and sideoats grama, which was seeded between rows in Blocks I and II, is mowed and doing well.

Silvicultural Practices: Minor pruning has been done each year to remove dead or damaged branches.

Evaluations and Measurements: Plant performance data is recorded during the growing season for the first three years. After the third year, data is gathered according to a specific schedule. The trees and shrubs were evaluated for survival, canopy width, plant height, vigor, insect and disease, and animal damage. Select data appears in this report. Annual summary reports have been prepared since 2006 and can be requested from the PMC.

Added species and rationale:

On May 13, 2014:

- Added 'Catskill' dwarf sand cherry *Prunus pumila* var. *depressa* L. accession 9051508 from Big Flats Plant Materials Center, Big Flats, New York. A non-invasive 1997 release with prostrate growth and immense root system. It grows well on gravelly or sandy soils along streams but has performed well on silt loam and calcareous soils. It is often used in shoreline and streambank stabilization practices and riparian buffer plantings, where low vegetation is preferred, including areas with ice floe issues. Suggested adaptation is hardiness zones 3b to 6b.

- 'Tiger Eyes' staghorn sumac (accession 9092143) was removed from Block 1A, Row 10, 1-5 because there were no remaining live plants. These were replaced by the 'Catskill' sand cherry listed above.

Evaluation:

On September 3, 2014:

- Information was collected on 21 selected entries. Crown spread and plant height were recorded along with observational notes relative to vigor, disease and insect damage, drought and cold tolerance, fruit production, survival, and predator damage.
- The inventory was completed and the planting plan was updated. Grass between the rows of trees was mowed during the growing season and the plots looked very good from a maintenance standpoint, with one exception. A dead Scots pine in Block IV, row 3 needs to be cut up with a chain saw for removal. The sand cherry added in the spring performed well in their first season in this planting.

Plant Performance:

- One hundred and eighteen accessions of 95 species are being evaluated. Maintenance on this site is excellent and most species are doing very well. Refer to BE-2 for detailed performance information.

The following accessions exhibit potential for further evaluation and use. Seeds from 9069164 Mongolian Scots pine were collected, grown out and provided for field plantings in 2013 and 2014. 'McKenzie' black chokeberry is currently in big demand by growers from across the globe. It is particularly prized by wineries. There are many requests to grow birch in conservation plantings. Continuing evaluations of 9082667 gray birch will determine adaptability to conservation growing conditions. Further study of gray birch on a less droughty site would have merit (CTSG-1, 2, 3, and 4).

9019586 green ash	9082711 winterberry euonymus
9094417 Manchurian ash	9076729 gray dogwood
9069164 Mongolian Scots pine	9082632 Mongolian pea shrub
9082891 common ninebark	9082712 bittersweet
Schubert chokecherry	'Arnold's Red' honeysuckle
9069162 Dahurian larch	9092051 northern catalpa
9069168 Siberian larch	9082667 gray birch
9082610 Siberian larch	9069162 Dahurian larch
9030971 amur maple	9076737 black cherry
9063148 corktree	9057406 rugosa rose
9092053 staghorn sumac	9094419 'Cinderella' honeyberry (haskap)
9082888 American hazelnut	9094420 'Berry Blue' honeyberry (haskap)
9082719 'Nero' chokeberry	

Figure BE-1. Sand Plain Experimental Farm layout

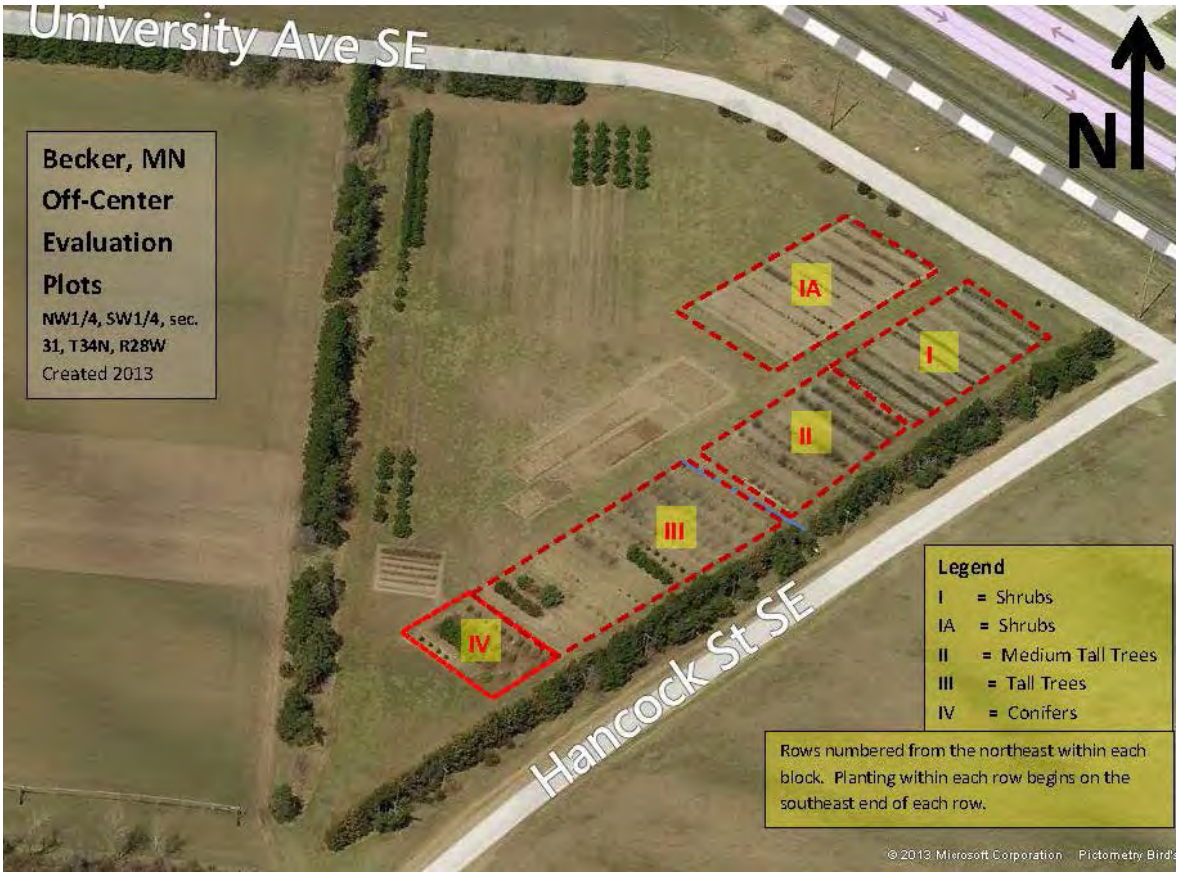

Figure BE-2. Becker Woody Off-Center Evaluation Planting – Plot Layout

Row	BLOCK IV CONIFERS			
5				
4		Canaan fir		
3	9069163 Dahurian larch	9069164 Scots pine		
2	9069168 Siberian larch	9069162 Dahurian larch		
1	9082610 Siberian larch	9082611 Siberian larch		South
Row	BLOCK III TALL TREES			
14	9082739 ironwood	9092231 lodgepole pine		
13	9082639 northern pin oak	cedar		
12	9094334 American linden	9094417 Manchurian ash		
11	ND-686 Pekin lilac	9094336 Freeman maple		
10	9082885 aspen (Towner)	9082633 black ash		
9	9082609 Meyer's spruce	9094416 sycamore		
8	9076735 Ohio buckeye	9076737 black cherry		
7	9069178 red pine	9076731 bur oak		
6	Hunter ponderosa pine	9063148 amur corktree		
5	9063127 white ash	9076730 silver maple		
4	9063115 green ash	9063116 black ash		
3	Cardan green ash	9019586 green ash		
2	Oahe hackberry	9019578 hackberry		
1	9076739 oak hybrid	9069177 bur oak		
Row	BLOCK II MEDIUM TALL TREES			
9	9082667 gray birch	9092051 northern catalpa		
8	9092052 swamp white oak	9082675 Manchurian ash		
7	9094406 Princeton elm	Carmine Jewel dwarf cherry		
6	9091968 Kentucky coffeetree	9069121 mayday		
5	McDermand Ussurian pear	9076733 nannyberry		
4	Prairie Harvest hackberry	Oahe hackberry		
3	9047209 chokecherry	ND-1733 plum		
2	9030971 amur maple	Schubert chokecherry		
1	Roselow sarg. crabapple	Midwest Manch. crabapple	BLOCK 1A SHRUBS	
			Cinderella haskaps | Berry blue haskaps | 9094418 hazel	
Row	BLOCK I SHRUBS		apricot|Caragana frutex|skunkbush sumac|pin cherry	
10	Legacy late lilac	9019621 lilac	Catskill sandcherry | nannyberry | MO hazelnut | MO plum	
9	Scarlet Mongolian cherry	9019579 Sib. pea shrub	com. ninebark|Am. hazelnut|PrairieRed plum|staghorn sumac	
8	Konza aromatic sumac		mugo pine|seaberry|wayfaring bush|roundleaf hawthorn	
7	9019576 juneberry	Shadblow svcbry|arrowwood	pr. rose|M. gooseberry	pin cherry|b.l. honeysuckle
6	9019581 Pekin cotoneaster	9019605 sand cherry	leadplant|chokeberry	chokecherry|Red River pr.cordgr.
5	Centennial E. cotoneaster	ND-170 Euro. cotoneaster	Nero chokbry|Viking chokb	winterberry E.| bittersweet
4	|roughleaf dogwd|A	Amber sk.sumac|Am.h.cranb.	|rugosa rose	black currant|cupplant
3	9076729 gray dogwood | (open) |	9094333 elderberry	chokeberry|Sib.dogwood	slough sedge | sweetgrass
2	9019580 redosier dogwood	Indigo silky dogwood	Survivor false indigo	9082632 Mong. pea shrub
1	Arnolds Red honeysuckle	9063143 r.t. honeysuckle	9019611 golden currant	Silver Sands sandbar willow
	revised 5/14			

Table No. BE-1: 2014 Weather Summary - Official Station - Elk River, Minnesota

	Mean Temperature (degrees Fahrenheit)		Precipitation (inches) Actual		Deviation from Normal
Month	**2014**	**Normal***	**2014****	**Normal***	**2014**
January	5.7	9.1	0.99	0.73	0.26
February	5.4	15.6	M	0.71	n/a
March	21.7	31.4	M	1.65	n/a
April	40.5	46.6	M	2.99	n/a
May	57.1	58.2	M	3.46	n/a
June	69.0	68.0	M	4.64	n/a
July	70.5	72.5	2.02	4.21	-2.19
August	71.4	70.3	M	3.88	n/a
September	60.7	61.6	M	3.96	n/a
October	48.0	47.9	0.74	2.60	-1.86
November	24.2	35.6	M	1.67	n/a
December	23.3	14.4	1.05	0.93	0.12
Annual	**41.5**	**44.3**	**n/a**	**31.42**	**n/a**

* National Climate Data Center 1981-2010 Monthly Normals
** Missing data

	2014
Last Frost (28 degrees)	19-Apr
First Frost (28 degrees)	31-Oct
Frost Free Period	196 days

Key to Table BE-2. 38I347K Field Evaluation of Woody Plant Materials – Becker, Minnesota

PLOT LOCATION = plot location of the plant material within the evaluation
ACCESSION NUMBER = any accession number, PI number or cultivar name assigned to the plant material
PLANT SYMBOL = plant symbol of the genus and species (asterisk indicates the symbol is not official)
GENUS/SPECIES = common name and scientific name of the plant material
ORIGIN/SOURCE = origin and/or source of the plant material
TRANS DATE = month and day the plant material was transplanted at the evaluation site
YR PLT = year the plant materials were transplanted at the evaluation site
YR REC = year of record
MATL PLTD = type of material planted, PLBR = bareroot, CONT = containerized
NO PLTS = number of plants planted in the plot
NO SRV = number of plants surviving
PCT SRV = percent of plants surviving
VI = plant vigor (1=excellent, 3=good, 5=fair, 7=poor, 9=very poor)
CAN COV (ft) = canopy cover measured in feet
PLT HT (ft) = plant height measured in feet

Table BE-2.
Project No.: 38I347K Field Evaluation of Woody Plant Materials, Becker, Minnesota
Year of Record: 2014

PLOT LOCATION	ACCESSION NUMBER	PLANT SYMBOL	GENUS/SPECIES ORIGIN/SOURCE	TRANS DATE	YR PLT	YR REC	MATL PLTD	NO PLTS	NO SRV	PCT SRV	VI	CAN COV (ft)	PLT HT (ft)	REMARKS
I/1/1-10	'Arnolds Red'	LOTA	red tatarian honeysuckle	1-May	96	96	CONT(P)	10	10	100	4	2.0	2.1	
	9069080		*Lonicera tatarica*			97			10	100	5	1.8	2.1	
			Lee Nursery, Fertile, MN			98			10	100	2	2.6	4.1	
			USDA, NRCS, PMC, Bismarck, ND			00			10	100	4	4.4	5.3	
						02			10	100	3	4.8	6.1	All fair fruit; yellow leaf tips
						05			10	100	4	5.0	7.3	
						10			10	100	4	6.8	8.2	
I/1/11-20	'Hawkeye'	LOTA	red tatarian honeysuckle	1-May	96	96	CONT(P)	10	10	100	3	1.7	1.9	
	9063143		*Lonicera tatarica*			97			10	100	4	1.5	2.4	
			Iowa			98			10	100	2	2.2	3.0	
			Lincoln-Oakes Nursery, Bismarck, ND			00			10	100	2	5.1	5.2	
			USDA, NRCS, PMC, Bismarck, ND			02			10	100	2	5.8	6.5	
						05			10	100	3	6.7	7.7	good vigor
						10			10	100	6	3.2	7.1	
I/2/11-20	'Indigo'	COAM2	silky dogwood	1-May	96	96	PLBR	10	10	100	4	1.7	2.1	
	468117		*Cornus amomum*			97			9	90	2	3.2	2.9	
			USDA, NRCS, PMC, E. Lansing, MI			98			9	90	1	7.2	4.8	
						00			9	90	2	9.6	6.4	
						02			9	90	3	9.8	7.3	
						05			10	100	5	10.5	7.3	dieback on 1,2; resprout on 4
						10			10	100	6	5.0	6.2	50% dieback, mostly resprouts
I/3/1-10	9076729	CORA6	gray dogwood	1-May	96	96	PLBR	10	10	100	3	1.4	1.9	browse on 2,3
			Cornus racemosa			97			10	100	3	2.2	2.8	
			Lincoln-Oakes Nursery, Bismarck, ND			98			10	100	2	5.4	4.9	
						00			10	100	2	7.8	6.5	
						02			10	100	2	8.0	7.4	
						05			10	100	4	7.0	7.5	
						10			10	100	5	5.6	6.2	

Project No.: 38I347K Field Evaluation of Woody Plant Materials, Becker, Minnesota
Year of Record: 2014

PLOT LOCATION	ACCESSION NUMBER	PLANT SYMBOL	GENUS/SPECIES ORIGIN/SOURCE	TRANS DATE	YR PLT	YR REC	MATL PLTD	NO PLTS	NO SRV	PCT SRV	VI	CAN COV (ft)	PLT HT (ft)	REMARKS
I/3/6-10	9094333	SANIC4	common elderberry	4-May	10	10	PLBR	5	3	60	6	0.5	0.5	
			Sambucus nigra ssp. *canadensis*			11			4	80	6	0.7	0.9	
			Big Sioux Nursery, Watertown, SD			12			5	100	5	0.8	1.0	deer browse heavy, need tubes
						14			5	100	7	0.9	1.1	deer browse, need tubes, winter dieback
1/4/6-10	9094355	CODR	roughleaf dogwood	4-May	11	11	PLBR	5	4	80	5	0.6	1.8	
			Cornus drummondii			12			5	100	2	1.1	1.7	5 replant
			Big Sioux Nursery, Watertown, SD			13			5	100	4	4.8	1.0	drought-affected
1/4/11-15	'Autumn Amber'	RHTR	skunkbush sumac	7-May	09	09		5	5	100	3	1.1	0.7	
			Rhus trilobata			10			5	100	3	1.1	1.0	
			USDA, NRCS, PMC, Los Lunas, NM			11			5	100	2	2.0	0.9	no leaf spot
						13			5	100	3	3.6	1.0	
1/4/16-20	9094281	VIOPA2	American highbush cranberry	7-May	09	09		5	5	100	3	1.4	1.6	
			Viburnum opulus var. *americanum*			10			5	100	4	1.8	1.6	
			Big Sioux Nursery, Watertown, SD			11			5	100	3	n/a	n/a	
						13			5	100	6	2.3	2.1	leave burnt as fireblight, no stem lesions
I/5/1-10	'Centennial'	COIN16	European cotoneaster	1-May	96	96	PLBR	10	10	100	5	1.6	1.6	browse on 7
	113095		*Cotoneaster integerrimus*			97			9	90	4	1.6	1.6	some dieback on 2,7
	9005729		USDA, NRCS, PMC, Bismarck, ND			98			9	90	4	4.0	3.9	
			Lincoln-Oakes Nursery, Bismarck, ND			00			9	90	3	8.5	5.2	
						02			9	90	3	8.6	6.0	
						05			10	100	2	9.5	5.5	excellent fruit
						10			10	100	7	7.0	6.0	
I/5/11-20	ND-170	COIN16	European cotoneaster	1-May	96	96	PLBR	10	10	100	3	1.8	2.0	
	9005728		*Cotoneaster integerrimus*			97			10	100	5	2.1	2.0	leaf spots
			USDA, NRCS, PMC, Bismarck, ND			98			10	100	4	3.7	2.9	
			Lincoln-Oakes Nursery, Bismarck, ND			00			10	100	2	7.3	4.1	
						02			10	100	2	7.2	4.5	
						05			10	100	3	6.3	4.5	
						10			10	100	7	6.0	4.0	80% leaves gone 8/18

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I/6/1-10	9019581	COAC	Pekin cotoneaster	1-May	96	96	PLBR	10	10	100	5	1.0	1.6	
			Cotoneaster acutifolia			97			10	100	3	1.7	2.2	dieback
			Lincoln-Oakes Nursery, Bismarck, ND			98			10	100	3	3.9	3.6	
						00			10	100	3	6.3	4.9	
						02			10	100	3	6.9	5.6	
						05			10	100	5	6.5	5.5	fireblight on 6,7
						10			10	100	7	6.0	4.0	mostly resprouts
I/7/1-10	9019576	AMAL2	juneberry	1-May	96	96	PLBR	10	10	100	5	1.0	1.0	
			Amelanchier alnifolia			97			10	100	5	1.4	1.3	
			Lincoln-Oakes Nursery, Bismarck, ND			98			10	100	4	1.7	1.7	
						00			10	100	3	5.2	2.4	
						02			10	100	3	6.1	2.8	
						05			10	100	4	5.5	3.3	all are grown together
						10			10	100	5	6.0	4.3	
1/7/6-10	9091975	AMLA9	serviceberry	12-May	05	05		5	5	100	6	0.6	1.2	1,4 browsed
			Amelanchier lamarckii			06			4	80	7	0.4	1.0	
			Lincoln-Oakes Nursery, Bismarck ND			07			4	80	4	0.6	1.4	
						09			4	80	5	0.8	1.0	
						11			4	80	4	1.5	1.6	
						14			4	80	7	3.3	3.1	no browse
1/7/11-15	9091976	VIDE	arrowwood viburnum	12-May	05	05		5	5	100	6	0.6	1.7	dead leaves on 1,4
			Viburnum dentatum			06			2	40	5	0.8	1.4	
			Lincoln-Oakes Nursery, Bismarck, ND			07			4	80	4	1.3	2.1	
						09			4	80	4	1.3	2.1	
						11			4	80	3	1.8	2.3	
						14			4	80	4	2.2	2.3	

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I/8/1-10	'Konza'	RHAR4	aromatic sumac	1-May	96	96	PLBR	10	7	70	6	0.7	1.1	
	477981		*Rhus aromatica*			97			7	70	4	1.9	1.9	top dieback - winter injury
			NRCS, PMC, Manhattan, KS			98			7	70	3	5.2	3.5	leaf fungus on 5,6,7,9
			Lincoln-Oakes Nursery, Bismarck, ND			00			7	70		8.3	4.2	
						02			7	70	4	9.2	4.8	
						05			9	90	4	9.5	5.1	
						10			10	100	3	9.0	5.0	
I/9/1-10	'Scarlet'	PRFR2	Mongolian cherry	1-May	96	96	PLBR	10	10	100	3	1.1	1.3	
	478003		*Prunus fruticosa*			97			10	100	4	1.6	1.8	severe rabbit damage on 1
			NRCS, PMC, Bismarck, ND			98			10	100	3	2.9	2.7	all suckering
			Lincoln-Oakes Nursery, Bismarck, ND			00			10	100	3	6.8	3.2	
						02			10	100	2	6.8	3.8	
						05			10	100	4	7.3	4.4	variable heights
						10			10	100	3	4-8	3-5	vaiable, good vigor, grown together
I/9/11-20	9019579	CAAR18	Siberian pea shrub	1-May	96	96	PLBR	10	10	100	5	0.8	2.0	browse on all
			Caragana arborescens			97			10	100	6	1.1	2.5	
			Lincoln-Oakes Nursery, Bismarck, ND			98			10	100	5	2.0	3.7	insect damage 4,5
						00			10	100	4	4.2	5.0	
						02			10	100	3	6.1	6.2	
						05			10	100	5	6.5	6.9	leaf defoliation
						10			10	100	5	4-6	4-8	lots of variation
I/10/1-10	'Legacy'	SYVI3	late (villosa) lilac	1-May	96	96	PLBR	10	10	100	6	0.6	1.1	resprout on 7,9
	ND-83		*Syringa villosa*			97			10	100	10	0.7	1.3	
	540443		NRCS, PMC, Bismarck, ND			98			10	100	4	1.3	1.9	
	9006228		Lincoln-Oakes Nursery, Bismarck, ND			00			10	100	4	3.5	3.2	
						02			10	100	4	4.6	4.1	
						05			10	100	5	4.5	4.2	variable heights
						10			10	100	5	3-5	2-5	variable heights

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I/10/11-20	9019621	SYVU	common lilac	1-May	96	96	PLBR	10	10	100	5	1.0	1.6	better than late lilac
			Syringa vulgaris			97			10	100	5	1.1	2.2	mildew on 1,8
			Lincoln-Oakes Nursery, Bismarck, ND			98			10	100	3	1.9	2.9	
						00			10	100	4	4.1	4.0	
						02			10	100	3	5.2	5.2	
						05			10	100	4	5.3	6.3	variable heights
						10			10	100	5	4.7	5.5	
IA/1/1-10	9019611	RIAU	golden currant	1-May	96	96	PLBR	10	10	100	4	1.2	2.1	
			Ribes aureum			97			10	100	6	2.0	2.4	
			Lincoln-Oakes Nursery, Bismarck, ND			98			10	100	7	3.0	3.7	
						00			10	100	3	5.2	4.2	
						02			10	100	4	5.6	4.4	
						05			10	100	5	4.7	4.5	leaves mostly gone-leaf spot
						10			10	100	5	4-6	3-6	leaves 95% gone 8/18
IA/1/11-20	Silver Sands	SAIN	sandbar willow	1-May	96	96	CONT(S)	10	0	0				
	Germplasm		*Salix interior*			97			3	30	5	1.1	2.0	
	ND-3902		USDA, NRCS, PMC, Bismarck, ND			98			8	80	6	0.8	1.3	rabbit browse on all
	9035212					00			10	100	2	8.4	5.2	
						02			10	100	2	9.1	6.4	
						05			10	100	2	9.0	7.5	
						10			10	100	3	10.0	7.0	
IA/2/1-10	Survivor	AMFR	false indigo	1-May	96	96	PLBR	10	10	100	3	2.3	2.7	browse on all
	Germplasm		*Amorpha fruticosa*			97			10	100	4	3.0	2.2	
	9008041		NRCS, PMC, Bismarck, ND			98			10	100	3	6.3	3.6	
			Lincoln-Oakes Nursery, Bismarck, ND			00			10	100	3	8.2	4.4	
						02			10	100	3	9.6	5.0	
						05			10	100	2	10.0	5.5	
						10			10	100	5	8.4	4.2	

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1A/2/11-20	9082632	CAIN	Mongolian peashrub	29-Apr	99	99	PLBR	10	10	100	3	0.8	1.0	
			Caragana intermedia			00			10	100	3	2.1	1.7	
			Lawyer Nursery, Plains, MT			01			9	90	4	3.6	2.6	
						03			9	90	4	4.8	3.4	
						05			9	90	3	6.0	3.9	
						08			9	90	4	7.3	4.4	dieback on 8, good seed on 10
						13			10	100	5	11.4	5.6	
1A/3/1-5	'McKenzie'	PHME13	black chokeberry	3-May	00	00	PLBR	5	5	100	2	1.6	1.7	
	323957		*Photinia melanocarpa*			01			5	100	3	2.3	2.4	
			Lincoln-Oakes Nursery, Bismarck, ND			02			5	100	2	3.6	2.9	
						04			5	100	2	4.1	3.2	
						06			5	100	2	6.4	4.2	
						09			5	100	2	6.8	4.9	
						14			5	100	2	7.6	6.4	all have fruit
1A/3/6-10	9082664	COALS2	Siberian dogwood	5-May	00	00	PLBR	5	5	100	2	1.5	2.7	
			Cornus alba var. *sibirica*			01			5	100	3	3.9	3.1	
			Lawyer Nursery, Plains, MT			02			5	100	2	5.8	4.4	
						04			5	100	3	5.6	5.3	
						06			5	100	4	6.8	5.3	
						09			5	100	5	6.7	5.4	
						14			5	100	6	3.8	4.6	dieback on all
1A/4/6-10	9057406	RORU	rugosa rose	16-May	01	01	PLBR	5	5	100	4	1.2	1.2	
			Rosa rugosa			02			5	100	3	2.7	2.0	
			Lincoln-Oakes Nursery, Bismarck, ND			03			5	100	3	3.6	2.2	
						05			5	100	3	5.3	3.0	good vigor
						07			5	100	2	7.6	3.5	
						10			5	100	2	10.0	4.0	

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1A/4/11-15	Riverview	RIAM2	American black currant	16-May	01	01	PLBR	5	5	100		1.5	1.9	
	Germplasm		*Ribes americanum*			02			5	100	3	4.0	2.6	
	9082687		Big Sioux Nursery, Watertown, SD			03			5	100	3	3.6	3.2	
						05			5	100	3	5.5	3.5	
						07			5	100	3	5.9	3.9	
						10			5	100	3	5.5	3.5	
1A/4/16-20	9082714	SIPEP	cupplant		02	02	CONT	5	5	100	3	0.6	0.3	
			Silphium perfoliatum			03			5	100	3	1.1	3.5	
			USDA, NRCS, PMC, Bismarck, ND			04			5	100				all five okay, height varies
						06			5	100			3.5	all five okay, flowering
						08			5	100			5.5	good growth, some drought stress
1A/5/1-5	'Nero'	PHME13	chokeberry		02	02	PLBR	5	5	100	3	1.0	1.5	
	9082719		*Photinia melanocarpa*			03			5	100	4	1.4	1.9	
			Northwoods Nursery, Molalla, OR			04			5	100	4	1.7	2.0	
						06			5	100	3	3.2	3.0	
						08			5	100	3	3.7	3.4	
						11			5	100	3	4.0	3.9	good fruit
1A/5/6-10	'Viking'	PHME13	chokeberry		02	02	PLBR	5	5	100	3	1.1	1.4	
	9082720		*Photinia melanocarpa*			03			5	100	3	1.8	2.0	
			Northwoods Nursery, Molalla, OR			04			5	100	3	2.3	2.1	
						06			5	100	2	4.0	3.2	
						08			5	100	2	4.4	3.2	
						11			5	100	3	5.1	4.0	good fruit
1A/5/11-15	9082711	EUBU6	winterberry euonymus		02	02	PLBR	5	5	100	3	0.5	2.6	
			Euonymus bungeanus			03			5	100	3	1.4	3.0	
			Lincoln-Oakes Nursery, Bismarck, ND			04			5	100	4	2.6	3.2	3 has seed
						06			5	100	4	4.1	4.1	dark pink fruit on 3
						08			5	100	3	4.5	4.6	upright form on 2
						11			5	100	3	4.6	5.6	

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1A/5/16/20	9082712	CESC	bittersweet		02	02	PLBR	5	5	100	3	0.5	1.0	
			Celastrus scandens			03			5	100	3	1.2	2.4	
			Lincoln-Oakes Nursery, Bismarck, ND			04			5	100	4	1.2	3.2	berries on 4
						06			5	100	3	2.6	3.4	
						08			5	100	3	3.1	2.8	all female
						11			5	100	3	2.8	3.1	
1A/6/1-5	9082678	AMCA6	leadplant		02	02	PLBR	5	5	100	2	0.6	1.0	
			Amorpha canescens			03			5	100		1.4	1.3	
			Lincoln-Oakes Nursery, Bismarck, ND			04			5	100	4	1.5	1.3	
						06			5	100	3	1.9	2.2	
						08			5	100	3	3.0	2.2	
						11			5	100	4	3.3	2.4	
1A/6/6-10	9091971	PHME13	black chokeberry	12-May	05	05		5	5	100	3	1.5	2.1	
			Photinia melanocarpa			06			5	100	2	2.1	2.4	
			Bailey Nurseries, Inc.			07			5	100	3	3.2	2.7	
						09			5	100	3	4.3	3.6	sprouts from layering
						13			5	100	2	5.8	4.2	
						14			5	100	3	4.8	4.4	some fruit
1A/6/11-15	9008183	PRVI	common chokecherry	12-May	05	05		5	5	100	3	0.8	1.8	
			Prunus virginiana			06			5	100	5	1.5	2.6	
			Lincoln-Oakes Nursery, Bismarck, ND			07			5	100	3	2.2	3.8	1,5 yellow leaves; 3 powdery mildew
			Sheridan County, ND			09			5	100	4	4.5	5.5	tent caterpillars on 1
						11			5	100	3	5.6	4.2	
						14			5	100	3	6.2	8.8	
1A/7/1-5	9082706	ROAR3	prairie rose		03	03		5	5	100	4	1.2	1.2	
			Rosa arkansana			04			5	100	6	0.7	0.6	
			Bismarck, ND			05			3	60	5	2.3	1.3	
			Lincoln-Oakes Nursery, Bismarck, ND			07			3	60	3	2.3	1.3	
						09			3	60	5	2.6	1.4	
						11			3	60	2	4.1	1.2	

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1A/7/6-10	9082746	RIMI	Missouri gooseberry		03	03	PLBR	5	5	100	6	1.4	1.4	
			Ribes missouriense			04			5	100	5	1.4	1.6	
			Big Sioux River, Watertown, SD			05			5	100		2.5	2.0	
			Big Sioux Nursery, Watertown, SD			07			5	100	7	1.9	1.7	severe leaf spot on all
						09				needs removal				
1A/7/11-15	9091967	PRPE2	pin cherry	12-May	05	05		5	5	100	3	1.5	2.2	
			Prunus pensylvanica			06			5	100	4	2.5	3.1	
			Big Sioux Nursery, Watertown, SD			07			5	100	3	4.2	3.8	
						09			5	100	5	6.9	6.3	
						11			5	100	3	7.9	9.3	
						14			5	100	3	9.5	10.0	
1A/7/16-20	'Freedom'	LOKO2	blueleaf honeysuckle		03	03	PLBR	5	5	100	4	2.2	2.2	
			Lonicera korolkowii			04			5	100	3	4.7	4.0	
			Lincoln-Oakes Nursery, Bismarck, ND			05			5	100	2	5.5	4.9	clean leaves, no disease
						09			5	100	2	9.3	8.1	
						12			5	100	1	12.0	10.0	
1A/8/1-5	9082889	PIMU80	Mugo pine	12-May	04	04	PLBR	5	5					no measurements taken
			Pinus mugo			05			4	80	5	0.4	0.4	
			Big Sioux Nursery, Watertown, SD			06			4	80	4	0.9	0.7	
						08			4	80	4	1.8	1.4	
						10			4	80	3	2.9	2.8	
						13			4	80	1	4.7	4.4	
1A/8/6-10	9082887	HIRH80	seaberry	20-May	04	04	PLBR	5	5	100	4	0.6	1.6	
			Hippophae rhamnoides			05			5	100	4	1.1	1.6	
			Lincoln-Oakes Nursery, Bismarck, ND			06			4	80	4	1.5	1.9	
						08			4	80	3	3.1	3.1	
						10			4	80	3	4.5	3.8	
						13			4	80	2	5.8	4.7	

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1A/8/11-15	9082642	VILA	wayfaring bush	20-May	04	04	PLBR	5	5	100	5	0.9	1.3	
			Viburnum lantana			05			5	100	5	0.8	1.2	
			Lincoln-Oakes Nursery, Bismarck, ND			06			5	100	4	0.8	1.2	winter injury on 4,5
						08			5	100	5	1.3	1.4	sun scald, chlorosis on all
						10			5	100	6	1.9	2.4	stressed, yellow leaf margins
						13			5	100	3	2.3	2.6	
1A/8/16-20	9076686	CRCH	roundleaf hawthorn	20-May	04	04	PLBR	5	4	80	4	0.6	0.7	
			Crataegus chrysocarpa			05			5	100	4	0.8	0.9	
			Lincoln-Oakes Nursery, Bismarck, ND			06			5	100	5	1.0	1.4	cedar apple rust on all, wooly aphids 3
						08			5	100	5	1.7	2.2	powdery mildew
						10			5	100	5	2.6	2.9	heavy rust
						13			5	100	5	1.8	3.1	heavy deer browse
1A/9/1-5	9082891	PHOP	common ninebark	20-May	04	04	PLBR	5	5	100	3	1.3	1.6	
			Physocarpus opulifolius			05			5	100	4	2.5	1.9	
			Big Sioux Nursery, Watertown, SD			06			5	100	3	4.6	3.2	
						08			5	100	2	5.9	6.0	
						10			5	100	2	7.0	7.0	
						13			5	100	3	8.1	6.7	some apical tip dieback on all (5% foliage)
1A/9/6-10	9082888	COAM3	American hazelnut	20-May	04	04	PLBR	5	4	80	4	0.7	1.1	
			Corylus americana			05			5	100	4	1.0	1.5	
			Lincoln-Oakes Nursery, Bismarck, ND			06			5	100	3	1.6	1.7	
						08			5	100		3.3	2.9	all browsed
						10			5	100	2	3.0	4.0	
						13			5	100	2	4.8	5.4	
IA/9/11-15	'Prairie Red'	PRUNU	hybrid plum	4-May	06	06	PLBR	5	5	100	3	0.8	1.6	
	9047203		*Prunus* sp.			07			5	100	3	1.0	1.8	
			Big Sioux Nursery, Watertown, SD			08			5	100	3	1.4	1.9	all browsed
						10			5	100	5	2.2	3.0	
						11			5	100	4	4.3	4.5	

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IA/9/16-20	9092053	RHTY	staghorn sumac	4-May	06	06	PLBR	5	5	100	2	3.9	3.9	
			Rhus typhina			07			5	100	4	4.5	5.1	
			Lincoln-Oakes Nursery, Bismarck, ND			08			5	100	4	5.3	4.4	deer rub on 2
						10			5	100	4	6.0	6.2	
						12			5	100	3	7.3	6.6	
IA/10/1-5	9092143	RHTY	staghorn sumac	May	07	07		5	1	20	3	1.5	1.0	
	'Tiger Eyes'		*Rhus typhina*			08			5	100	3	0.9	1.2	
			S&B Nursery, Bismarck, ND (Bailey's, St. Paul, MN)			09			4	80	3	1.6	1.8	
						11			5	100	3	1.5	1.2	
						13			5	100	8		1.3	in 5-ft tree shelters
						14			0	0				all dead
1A/10/1-5	'Castskill'	PRPUD	sand cherry			14		5	5	100	3	2.9	0.5	
			Prunus pumila var. *depressa*											
			Big Flats PMC, Corning, NY											
1A/10/6-10	9092141	VILE	nannyberry	May	07	07		5	5	100	3	0.5	1.6	2,3,5 powdery mildew
			Viburnum lentago			08			5	100	3	1.2	1.7	
			Schumacher's Nursery, Heron Lake, MN			09			5	100	4	0.8	1.8	powdery mildew on all
						11			5	100		1.9	2.8	powdery mildew on all
						13			5	100	3	2.7	3.2	
IA/10/11-15	Sun Harvest	COAM3	American hazelnut	May	07	07		5	3	60	4	0.4	1.8	
	Germplasm		*Coylus americana*			08			5	100	4	0.7	1.6	all browsed
	9083247		USDA, NRCS, PMC, Elsberry, MO			09			5	100	5	2.1	1.7	
						11			5	100	3	4.2	3.4	
						13			5	100	4	4.2	3.8	
IA/10/16-20	Midwest	PRAM	American plum	May	07	07		5	3	60	4	0.4	1.3	
	Premium Germplasm		*Prunus americana*			08			3	60	6	0.3	1.0	
	9083241		USDA, NRCS, PMC, Elsberry, MO			09			4	80	5	0.8	1.1	deer browse on all
						11			4	80	5	2.4	2.4	
						13			4	80	4	2.0	2.2	narrow leaves, sparse foliage

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IA/11/1-5	9082895	PRAR3	apricot	May	07	07		5	3	60	4	0.9	1.0	
			Prunus armeniaca			08			3	60	4	1.8	2.6	
			Rod O'Clair, Jamestown, ND			09			3	60	5	3.8	4.5	
			USDA, NRCS, PMC, Bismarck, ND			11			3	60		7.3	10.0	
						13			3	60	1	9.8	10.8	
IA/11/6-10	9091969	CAFR80	Russian peashrub	May	07	07		5	5	100	4	0.3	1.4	
			Caragana frutex			08			5	100	5	0.4	1.4	
			Big Sioux Nursery, Watertown, SD			09			5	100	4	0.6	1.5	
						11			4	80	6	0.7	1.6	
						13			4	80	7	0.6	1.2	
IA/11/11-15	9091964	RHTR	skunkbush sumac	May	07	07		5	5	100	2	0.9	1.8	
			Rhus trilobata			08			5	100	4	2.7	2.0	chlorosis
			Cave Hills, SD			09			5	100	4	3.8	2.4	
			USDA, NRCS, PMC, Bismarck, ND			11			5	100	3	3.8	2.6	
						13			5	100	4	4.1	2.5	50-75% leaves dropped
IA/11/16-20	9091967	PRPE2	pin cherry	8-May	08	08		5	5	100	4	0.4	1.7	all browsed
			Prunus pensylvanica			09			4	80	4	0.8	1.6	
			Big Sioux Nursery, Watertown, SD			10			4	80	5	1.6	2.1	
						12			4	80	5	1.4	1.3	
						14			1	20	8	0.4	0.8	most appear dead
1A/12/1-5	'Cinderella'	LOED	honeyberry (haskaps)	16-May	13	13	POTD	5	5	100	7	1.0	1.0	50% dead leaves, need water
	9094420		*Lonicera edulis*			14			5	100	5	1.5	1.5	
			Jeffries Nursery, Portage LaPrairie, MB											
1A/12/6-10	'Berry Blue'	LOED	honeyberry (haskaps)	16-May	13	13	POTD	5	5	100	7	1.2	1.6	30% dead leaves, need water
	9094419		*Lonicera edulis*			14			5	100	5	1.5	1.5	some deer browse on all
			Jeffries Nursery, Portage LaPrairie, MB											
1A/12/11-15	9094418	PLBR	American hazel	16-May	13	13	PLBR	5	5	100	6	0.4	0.9	
			Corylus americana			14			5	100	7	0.8	0.8	all browsed
			Big Sioux Nursery, Watertown, SD											

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II/1/1-5	'Roselow'	MASA9	Sargent crabapple	1-May	96	96	PLBR	5	4	80	4	1.4	2.0	browse on 4
	PI-477986		*Malus sargentii*			97			4	80	2	2.0	2.3	
			USDA, NRCS, PMC, East Lansing, MI			98			4	80	3	3.5	3.4	
			Lincoln-Oakes Nursery, Bismarck, ND			00			4	80	3	6.7	5.5	
						02			4	80	3	7.1	6.9	no leaf diseases
						05			4	80	3	6.0	8.1	
						10			4	80	4	14.3	7.9	
II/1/6-10	'Midwest'	MAMA37	Manchurian crabapple	1-May	96	96	PLBR	5	5	100	3	1.6	2.5	browse on 1,3
	478000		*Malus mandshurica*			97			5	100	2	3.4	3.6	
			USDA, NRCS, PMC, Bismarck, ND			98			5	100	1	5.0	6.4	
			Lincoln-Oakes Nursery, Bismarck, ND			00			5	100	3	7.8	9.1	
						02			5	100	2	9.0	10.2	
						05			5	100	3	9.8	13.3	
						10			5	100	5	12.8	11.5	
II/2/1-5	9030971	ACGI	amur maple	1-May	96	96	PLBR	5	5	100	3	1.1	1.8	
			Acer ginnala			97			5	100	2	1.6	1.9	
			Lincoln-Oakes Nursery, Bismarck, ND			98			5	100	2	3.1	4.1	
						00			5	100	4	7.9	7.0	
						02			5	100	3	9.2	8.1	
						05			5	100	3	10.0	13.9	
						10			5	100	4	13.4	9.9	
II/1/6-10	'Schubert'	PRVI	chokecherry	1-May	96	96	PLBR	5	5	100	4	0.7	2.1	
	9012608		*Prunus virginiana*			97			5	100	1	1.5	2.6	
			Lincoln-Oakes Nursery, Bismarck, ND			98			5	100	1	2.4	3.5	
						00			5	100	2	5.8	6.5	
						02			5	100	2	8.1	9.0	
						05			5	100	2	10.0	11.8	
						10			5	100	3	10.4	13.0	

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II/3/1-5	9047209	PRVI	chokecherry	1-May	96	96	PLBR	5	5	100	3	0.7	2.0	
			Prunus virginiana			97			5	100	3	1.5	3.5	insect damage on 4
			Lincoln-Oakes Nursery, Bismarck, ND			98			5	100	1	2.5	5.3	some suckers on 3,4
						00			5	100	4	6.8	8.1	
						02			5	100	3	9.1	10.8	
						05			5	100	3	12.0	13.2	yellow fruit on 1
						10			5	100	4	13.8	14.1	fungus on 3
II/3/6-10	ND-1733	PRAM	plum	1-May	96	96	PLBR	5	5	100	3	1.3	2.4	
	9006060		*Prunus americana*			97			5	100	3	2.8	3.4	insect, disease damage
			Lincoln-Oakes Nursery, Bismarck, ND			98			5	100	3	4.0	6.3	
						00			5	100	3	10.7	9.0	
						02			5	100	2	11.4	10.5	
						05			5	100	4	9.9	11.9	
						10			5	100	5	10.8	9.9	
II/4/1-5	Prairie Harvest Germplasm	CEOC	hackberry	7-May	09	09		5	5	100	3	0.4	1.1	
	9034956		*Celtis occidentalis*			10			5	100	5	0.5	0.7	
			Polk County, MN			11			5	100	6	0.5	0.6	
			USDA, NRCS, PMC, Bismarck, ND			13			2	40	8	0.3	0.4	
II/4/6-10	'Oahe'	CEOC	hackberry	7-May	09	09		5	5	100	3	0.5	1.7	
			Celtis occidentalis			10			5	100	5	0.4	1.1	
			Big Sioux Nursery, Watertown, SD			11			5	100	7	0.5	0.6	
						13			3	60	7	0.6	1.6	
II/5/1-5	'McDermand'	PYUS	Ussurian pear	1-May	96	96	PLBR	5	5	100	3	1.0	2.5	browse on 1
	478004		*Pyrus ussuriensis*			97			5	100	3	2.4	3.3	leaf damage
			NRCS, PMC, Bismarck, ND			98			5	100	2	2.9	5.2	
			Lincoln-Oakes Nursery, Bismarck, ND			00			5	100	3	7.3	9.4	
						02			5	100	3	10.0	11.8	
						05			5	100	4	12.0	13.6	
						10			5	100	3	16.8	16.0	

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II/5/6-10	9076733	VILE	nannyberry	1-May	96	96	PLBR	5	5	100	5	0.3	0.7	
			Viburnum lentago			97			5	100	5	0.8	1.3	
			Turtle Mountains, ND			98			5	100	3	1.3	2.9	mildew on leaves
			Lincoln-Oakes Nursery, Bismarck, ND			00			5	100	4	3.9	4.7	
						02			5	100	5	4.4	5.4	
						05			5	100	4	3.8	5.8	red color on 3-5
						10			5	100	7	3.2	4.9	
II/6/1-5	9091968	GYDI	Kentucky coffeetree	4-May	11	11	PLBR	5	5	100	4	0.9	1.6	
			Gymnocladus dioicus			12			5	100	3		1.7	
			Big Sioux Nursery, Watertown, SD			13			4	80	6		1.3	very yellow leaves
II/6/6-10	9069121	PRPA5	mayday	1-May	96	96	PLBR	5	5	100	5	0.4	0.6	browse on 4,5
			Prunus padus			97			5	100	4	1.1	1.7	
			Norway			98			5	100	3	1.6	3.2	insect damage on 3,4
			USDA, NRCS, PMC, Bismarck, ND			00			5	100	3	3.7	6.1	
						02			5	100	3	5.4	9.2	
						05			5	100	4	5.7	10.3	
						10			4	80	6	5.8	7.6	
II/7/1-5	9094406	ULAM	American elm	8-May		12	PLBR	5	5	100	6	0.3	1.4	3' shelters and watered all 5/9/12
	'Princeton'		*Ulmus americana*			13			5	100	4		0.9	
			Schumacher's Nursery, Heron Lake, MN											
II/7/6-10	9094400	PRCE	dwarf cherry	8-May	12	12	PLBR	5	5	100	2	0.3	3.2	3' shelter and watered all 5/9/12
	'Carmine Jewel'		*Prunus cerasus*			13			5	100	2		3.3	deer eating leaves at tube tops
			Big Sioux Nursery, Watertown, SD			14			5	100	2		3.5	deer browsing above tube tops
II/8/1-5	9092052	QUBI	swamp white oak	4-May	06	06	PLBR	5	4	80	3	0.6	1.2	5 chewed off
			Quercus bicolor			07			4	80	3	0.8	1.3	
			Lincoln-Oakes Nursery, Bismarck, ND			08			4	80	4	1.1	1.3	
						11			4	80		2.7	2.1	
						12			4	80	3	2.7	2.3	all hedged by deer

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II/8/6-10	9082675	FRMA5	Manchurian ash	3-May	00	00	PLBR	5	5	100	2	0.8	2.2	
			Fraxinus mandshurica			01			5	100	4	1.2	2.3	
			Lincoln-Oakes Nursery, Bismarck, ND			02			5	100	4	2.0	4.0	
						04			5	100	5	1.9	5.7	
						06			5	100	5	2.6	6.4	
						09			5	100	6	2.2	6.3	
						14			5	100	6	1.9	5.2	
II/9/1-5	9082667	BEPO	gray birch	3-May	00	00	PLBR	5	5	100	2	1.3	3.6	
			Betula populifera			01			5	100		3.7	6.4	
			Lawyer Nursery, Plains, MT			02			5	100	2	5.4	9.8	
						04			5	100	3	8.1	14.5	
						06			5	100	3	9.6	16.4	drought stress
						09			5	100	3	10.6	19.0	
						14			5	100	2	15.0	24.3	
II/9/6-10	9092051	CASP8	northern catalpa	4-May	06	06	PLBR	5	5	100	3	0.6	0.8	
			Catalpa speciosa			07			4	80	3	0.8	1.0	
			Big Sioux Nursery, Watertown, SD			08			4	80	4	4.0	1.6	
						10			4	80	3	2.0	2.8	
						12			4	80	3	2.6	3.4	yellow leaves
III/1/1-5	9076739	QUERC	oak hybrid	30-Apr	98	98	CONT(P)	5	5	100	4	0.6	1.7	
			Quercus			99			4	80	6	1.2	2.4	browse on 4
			E.T. Jacobson, MN			00			4	80	3	2.4	3.9	
			USDA, NRCS, PMC, Bismarck, ND			02			4	80	5	3.9	6.2	
						04			4	80	6	4.5	7.3	acorns on 3
						07			4	80	4	6.6	8.3	
						12			4	80	3	8.8	10.5	2,4,5 basal sprouts, 5 hvy browse

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III/1/6-10	9069177	QUMA2	bur oak	30-Apr	98	98	CONT(P)	5	5	100	6	0.5	1.0	browse on 3
			Quercus macrocarpa			99			4	80	6	0.8	1.2	browse on 1,4
			E.T. Jacobson, MN			00			5	100	5	1.4	1.7	
			USDA, NRCS, PMC, Bismarck, ND			02			5	100	5	3.9	4.8	
						04			5	100	5	3.2	5.4	stem gall on 5
						07			5	100	5	4.7	6.6	deer browse 1; anthracnose 5
						13			5	100	2	8.0	10.4	
III/2/1-5	'Oahe'	CEOC	hackberry	1-May	96	96	PLBR	5	5	100	5	1.0	2.7	
	476982		*Celtis occidentalis*			97			5	100	5	1.7	2.7	4 browsed
			NRCS, PMC, Bismarck, ND			98			5	100	5	2.1	3.7	
			Lincoln-Oakes Nursery, Bismarck, ND			00			5	100	4	6.6	8.1	
						02			5	100	4	7.9	11.7	
						05			5	100	4	7.6	13.4	
						10			5	100	4	7.0	17.5	
III/2/6-10	9019578	CEOC	hackberry	1-May	96	96	PLBR	5	5	100	6	0.5	1.7	browse on 2,3,5
			Celtis occidentalis			97			5	100	6	1.7	2.8	browse on 3,4,5
			Lincoln-Oakes Nursery, Bismarck, ND			98			5	100	4	2.5	3.9	
						00			5	100	4	6.2	7.1	
						02			5	100	4	10.3	13.2	leaf gall
						05			5	100	4	10.4	14.7	
						10			5	100	4	11.5	21.0	
III/3/1-5	'Cardan'	FRPE	green ash	1-May	96	96	PLBR	5	4	80	5	0.4	1.6	
	469226		*Fraxinus pennsylvanica*			97			5	100	3	1.4	2.2	
			NRCS, PMC, Bismarck, ND			98			5	100	4	3.0	4.1	
			Lincoln-Oakes Nursery, Bismarck, ND			00			5	100	4	7.6	8.1	
						02			5	100	4	9.4	12.4	
						05			5	100	4	10.2	14.9	
						10			5	100	3	9.8	22.6	

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III/3/6-10	9019586	FRPE	green ash	1-May	96	96	PLBR	5	5	100	3	1.0	2.6	
			Fraxinus pennsylvanica			97			5	100	3	2.8	3.7	2 browsed
			Lincoln-Oakes Nursery, Bismarck, ND			98			5	100	3	5.3	6.7	
						00			5	100	3	9.3	11.2	
						02			5	100	3	11.5	14.9	
						04			5	100	3	10.4	17.1	
						05			5	100	3	12.4	18.3	
						10			5	100	3	7.6	27.2	
III/4/1-5	9063115	FRPE	green ash	1-May	96	96	CONT(P)	5	5	100	5	0.2	0.9	browse on 1,2,3,5
			Fraxinus pennsylvanica			97			5	100	3	1.0	2.0	leaf damage on 2
			Itasca State Park, MN			98			5	100	4	2.3	3.9	
			USDA, NRCS, PMC, Bismarck, ND			00			5	100	3	6.3	7.5	
						02			5	100	4	9.2	13.8	
						05			5	100	4	9.1	17.1	
						10			5	100	3	14.2	27.0	
III/4/6-10	9063116	FRNI	black ash	1-May	96	96	CONT(P)	5	5	100	5	0.3	1.3	browse on 2
			Fraxinus nigra			97			2	40	7	0.7	1.0	browse on 1
			Itasca State Park, MN			98			2	40	6	1.5	2.3	
			USDA, NRCS, PMC, Bismarck, ND			00			2	40	4	2.4	5.4	
						02			2	40	5	4.2	8.6	
						05			2	40	6	4.1	9.9	leaves yellowing-stress
						10			2	40	6	5.0	9.0	
III/5/1-5	9063127	FRAM2	white ash	1-May	96	96	PLBR	5	5	100	5	0.2	1.4	
			Fraxinus americana			97			5	100	4	1.6	2.3	slight insect damage on 2
			Wisconsin			98			5	100	4	2.1	3.8	
			Lincoln-Oakes Nursery, Bismarck, ND			00			5	100	5	4.5	8.9	
						02			5	100	4	7.6	12.9	
						05			5	100	4	7.3	14.9	
						10			5	100	3	7.2	20.8	

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Year of Record: 2014

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III/5/6-10	9076730	ACSA2	silver maple	1-May	96	96	PLBR	5	5	100	3	1.2	3.1	
			Acer saccharinum			97			5	100	1	3.8	5.2	
			Lincoln-Oakes Nursery, Bismarck, ND			98			5	100	3	8.7	9.5	
						00			5	100	3	14.2	15.7	
						02			5	100	4	13.3	16.9	
						05			5	100	4	12.9	19.0	broke off stump sprout on 2
						10			5	100	4	14.4	19.3	2 very small, few weak leaves
III/6/1-5	Hunter Germplasm	PIPOS	ponderosa pine	12-May	05	05		5	5	100	2	0.6	1.2	
			Pinus ponderosa var. *scopulorum*			06			5	100	2	1.2	1.6	
	9081843		USDA, ARS, Bridger, MT			07			5	100	2	2.1	2.5	
						09			5	100		4.1	4.6	
						11			5	100	3	6.6	7.3	
						14			3	60	5	10.2	8.8	2,3 dead; 4 very poor
III/6/6-10	9063148	PHAM2	amur corktree	1-May	96	96	CONT(P)	5	5	100	5	0.4	1.2	browse on 5
			Phellodendron amurense			97			5	100	3	2.8	2.6	
			Clay County, MN			98			5	100	3	4.9	4.8	
			USDA, NRCS, PMC, Bismarck, ND			00			5	100	3	8.5	6.8	
						02			5	100	3	10.4	8.7	
						05			5	100	4	10.5	9.9	tractor damage on trunk of 5
						10			5	100	3	11.8	11.1	
III/7/1-5	9069178	PIRE	red pine	29-Apr	99	99		5	5	100	4	1.0	1.3	
			Pinus resinosa			00			5	100	4	1.0	1.3	
			USDA, NRCS, PMC, Bismarck, ND			01			5	100	3	2.9	3.0	
						03			5	100	3	4.7	5.4	
						05			5	100	2	6.2	8.5	
						08			5	100	3	3.0	3.5	
						13			5	100	1	9.0	17.6	

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Year of Record: 2014

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III/7/6-10	9076731	QUMA2	bur oak	1-May	96	96	PLBR	5	5	100	5	0.2	1.3	browse on 1,2
			Quercus macrocarpa			97			4	80	6	0.8	1.3	
			Black Hills, SD			98			4	80	5	1.6	2.1	mod-severe rabbit damage
						00			4	80	4	2.6	4.3	
						02			4	80	5	4.3	6.5	leaf spot
						05			4	80	5	4.8	6.9	acorns, leaf spot on all, dieback 5
						10			4	80	5	6.6	9.1	
III/8/1-5	9076735	AEGL	Ohio buckeye	1-May	96	96	PLBR	5	5	100	4	0.2	0.6	
			Aesculus glabra			97			5	100	8	0.7	0.6	
			Lincoln-Oakes Nursery, Bismarck, ND			98			5	100	6	0.7	1.0	
						00			5	100	4	1.6	1.5	
						02			5	100	6	1.9	1.8	
						05			5	100	6	1.0	1.4	leaf burns/dieback on all
						10			3	60	8	1.5	1.2	
III/8/6-10	9076737	PRSE2	black cherry	1-May	96	96	PLBR	5	4	80	3	1.0	1.9	
			Prunus serotina			97			4	80	4	1.9	2.2	
			Apple Valley FEP			98			4	80	3	4.3	5.0	
			Lincoln-Oakes Nursery, Bismarck, ND			00			4	80	3	8.7	10.1	
						02			4	80	3	11.1	12.9	
						05			4	80	4	10.8	15.1	
						10			4	80	3	10.0	17.3	
III/9/1-5	9082609	PICEA	Meyer's spruce	16-May	01	01	CONT	5	3	60	5	0.8	0.7	
			Picea meyeri			02			3	60		1.0	0.9	
			Itasca Greenhouse, Cohasset, MN			03			3	60		1.2	1.1	
						05			3	60	3	1.6	1.4	
						07			3	60	5	2.2	1.6	
						10			3	60	1	3.0	2.0	4,5 replaced 6/15/11
III/9/6-10	9094335	TICO	littleleaf linden	4-May	10	10	PLBR	5	5	100	8	0.5	0.9	
			Tilia cordata			11			5	100	8	0.5	0.8	
			Big Sioux Nursery, Watertown, SD			12			5	100	6	0.4	0.4	all chewed off by deer; basal growth

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III/9/6-10	9094416	PLOC	sycamore	16-May	13	13	PLBR	5	5	100	2		2.2	
			Platanus occidentalis			14			5	100	5		2.2	
			Lincoln-Oakes Nursery, Bismarck, ND											
III/10/1-5	9082885	POTR5	aspen	20-May	04	04	PLBR	5	3	60	4	0.7	2.1	
			Populus tremuloides			05			4	80	5	1.1	1.9	
			NDFS Nursery, Towner, ND			06			5	100		1.4	2.2	
						08			5	100	4	1.8	2.2	
						10			5	100	4	2.4	1.6	
						13			2	40	6	1.7	1.2	
III/10/6-10	9082633	FRNI	black ash	29-Apr	99	99		5	5	100	6	0.3	0.7	browse on 4
			Fraxinus nigra			00			4	80	4	0.9	1.0	
			Lawyer Nursery, Plains, MT			01			4	80	4	1.0	2.1	
						03			4	80	4	1.1	3.2	
						05			4	80	5	1.7	3.5	
						08			4	80	4	1.1	3.2	
						13			4	80	8	0.5	0.9	weak basal resprouts, dead tops
III/11/1-5	ND-686	SYPE	Pekin lilac	1-May	96	96	PLBR	5	5	100	3	2.3	2.9	
	478008		*Syringa pekinensis*			97			4	80	5	2.4	2.3	winter damage
			Lincoln-Oakes Nursery, Bismarck, ND			98			4	80	3	4.6	3.7	
						00			4	80	4	6.9	5.9	
						02			4	80		8.1	6.9	
						05			4	80	6	7.0	6.9	
						10			4	80	4	7.8	6.9	fungus on 3
III/11/6-10	9094336	ACFR	Freeman maple	4-May	10	10	PLBR	5	3	60	8	0.5	1.2	
			Acer X freemanii			11			4	80	5	0.3	1.4	2 replants (5/4/11)
			Big Sioux Nursery, Watertown, SD			12			3	60	7	0.3	0.3	deer eating leaves to ground
						14			1	20	8	0.5	0.5	
III/12/1-5	9094334	TIAM	American linden	4-May	10	10	PLBR	5	5	100	5	0.7	1.5	
			Tilia americana			11			5	100	8	0.6	0.7	dieback on all
			Big Sioux Nursery, Watertown, SD			12			5	100	4	0.6	0.5	deer eaten all veg, basal resprout

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III/12/6-10	9094417	FRMA	Manchurian ash	16-May	13	13	PLBR	5	5	100	2		3.4	tubes
			Fraxinus mandshurica			14			5	100	3		5.1	
			China											
			Big Sioux Nursery, Watertown, SD											
III/13/1-5	9082639	QUEL	northern pin oak	29-Apr	99	99	PLBR	5	2	40	8	0.3	0.5	
			Quercus ellipsoidalis			00			2	40	6	1.1	0.9	
			Lincoln-Oakes Nursery, Bismarck, ND			01			2	40	6	1.0	2.5	
						03			2	40	4	2.4	4.1	
						05			2	40	?	2.3	5.6	leaf galls, army worms/galls
						08			2	40	4	4.3	7.9	
						13			2	40	5	10.3	12.0	
III/14/1-5	9082739	OSVI	ironwood	May	07	07		5	2	40	4	0.9	2.1	
			Ostrya virginiana			08			5	100	6	0.4	1.0	deer browse, chlorosis on 1
			Sertoma Park, Bismarck, ND			09			5	100	6	0.7	1.1	
			USDA, NRCS, PMC, Bismarck, ND			11			5	100	6	1.6	1.3	
						13			5	100	2		3.5	3 ft tubes installed in 2012
III/14/6-10	9092231	PICOL	lodgepole pine	7-May	09	09		5	5	100	4	0.5	1.1	needle burn on 4
			Pinus contorta var. *latifolia*			10			5	100	1	0.9	1.5	
						11			5	100	2	1.8	2.3	
						13			5	100	2	2.8	4.3	double leader 5
IV/1/1-5	9082610	LASI	Siberian larch	30-Apr	98	98	CONT(S)	5	5	100	4	0.5	1.0	
			Larix sibirica			99			5	100	6	0.8	1.5	
			NDFS Nursery, Towner, ND			00			5	100	5	1.3	2.1	
						02			5	100	4	3.1	5.0	
						04			5	100	5	3.9	6.9	
						07			5	100	3	6.5	11.2	
						12			5	100	1	10.3	16.9	

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IV/1/6-10	9082611	LASI	Siberian larch	30-Apr	98	98	CONT(S)	5	5	100	3	0.5	1.2	
			Larix sibirica			99			5	100	6	0.7	1.4	
			NDFS Nursery, Towner, ND			00			5	100	5	1.0	1.6	
						02			5	100	5	1.8	2.7	
						04			5	100	5	2.4	3.7	
						07			5	100	5	3.9	6.6	
						12			5	100	3	6.4	10.9	
IV/2/1-5	9069168	LASI	Siberian larch	30-Apr	98	98	CONT(P)	5	1	20	4	0.3	1.3	
			Larix sibirica			99			4	80	6	0.7	1.4	
			Russia			00			4	80	5	1.1	1.9	
			USDA, NRCS, PMC, Bismarck, ND			02			4	80	4	2.6	4.0	
						04			4	80	4	3.2	6.6	
						07			4	80	2	6.8	11.9	
						12			4	80	2	11.1	18.4	not as dark green as 9082610
IV/2/6-10	9069162	LARIX	Dahurian larch	30-Apr	98	98	CONT(P)	5	3	60	3	0.9	1.7	
			Larix olgensis			99			4	80	4	2.1	2.2	
			China			00			5	100	4	2.9	3.6	
			USDA, NRCS, PMC, Bismarck, ND			02			5	100	3	5.4	5.9	
						04			5	100	3	7.0	8.1	chlorotic, no leader on 4
						07			5	100	3	9.6	11.0	3 top dieback, deer damage 4
						12			5	100	3	13.8	19.5	thinner foliage than others
IV/3/1-5	9069163	LARIX	Dahurian larch	30-Apr	98	98	CONT(P)	5	0	0				
			Larix olgensis			99			1	20	5	1.0	2.0	
			China			00			4	80	5	1.3	2.0	
			USDA, NRCS, PMC, Bismarck, ND			02			4	80	5	2.6	3.8	
						04			4	80	6	4.2	6.8	
						07			3	60	3	9.2	13.8	
						12			3	60	2	14.2	25.2	medium dense foliage

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IV/3/6-10	9069164	PISYM	Scots pine	30-Apr	98	98	CONT(P)	5	2	40	4	0.6	1.0	
			Pinus sylvestris var. *mongolica*			99			5	100	4	1.3	1.8	
			China			00			5	100	3	2.4	2.7	
			USDA, NRCS, PMC, Bismarck, ND			02			5	100	3	5.2	6.2	
						04			5	100	3	7.9	10.9	
						07			5	100	3	14.5	16.3	
						12			4	80	1	20.8	23.1	

OFF-CENTER EVALUATION PLANTING: TECHNICAL REPORT 2014

Study NDPMC-T-0201-CP

Study Title: Eastern South Dakota Soil & Water Research Farm, Brookings, South Dakota

Purpose: The purpose of the farm is to find solutions to national and regional concerns related to soil and water conservation and the efficiency and sustainability of agricultural production. Research and technology transfer activities on the farm are conducted by a partnership including: USDA Agricultural Research Service, USDA Natural Resources Conservation Service, South Dakota State University, South Dakota Agricultural Experiment Station, the Brookings County Conservation District, as well as 14 other County Conservation Districts from eastern South Dakota.

History: The Eastern South Dakota Soil and Water Research Farm, Inc. is a non-profit organization consisting of a Board of Directors elected from each of 15 Soil and Water Conservation Districts in eastern South Dakota. Brookings, Codington, Clark, Day, Deuel, Hamlin, Kingsbury, Lake, Lincoln, Marshall, McCook, Minnehaha, Minor, Moody, and Turner Soil and Water Conservation Districts are represented on the Board of Directors. The purpose of the corporation is to promote research of efficient farm production practices that conserve soil and water resources.

The Brookings Research Farm consists of 80 acres located approximately one mile north of the campus of South Dakota State University. The soils on this farm are characteristic of those found in northeastern South Dakota and west central Minnesota and are similar to soils common to the northern Corn Belt. A new building was constructed in 2006. Some trees were removed during the construction.

Methods and Materials

Assembly: The first tree planting trials were started in 2000 when 16 species were planted. An additional six species were planted in 2001. These trials were used to showcase different types of tree species and various weed control methods.

In 2004, the PMC staff became involved in planting additional tree and shrub accessions to be evaluated on an annual basis. There are now 51 accessions of 37 different species under evaluation at this site. Refer to Table BR-2 for entries planted from 2004-2014.

For the 2014 weather summary at Brookings, see Table BR-1.

Planting Plan: The layout of the evaluation plots is shown in Figure BR-1 and Figure BR-2. The tree and shrub plots are in the northeastern area of the Research Farm.

Site Preparation: Strips to be planted are chemically killed with glyphosate, and then tree fabric is laid down.

Planting Method: All trees and shrubs are planted by hand, except those moved with a tree spade in 2008.

Weed/Pest/Plot Management: Between-row grass is clipped as needed during the growing season to control weeds and reduce fire danger. In-row fabric controls weeds well. Weeds do grow in the open spaces where the trees are planted. Additional maintenance and pruning is done during the fall evaluation.

Evaluations and Measurement: Plant performance data is recorded during the growing season for the first three years. After the third year, data is gathered according to a specific schedule. Records of planting date, survival, vigor, fruit (seed) amount, canopy width, plant height, winter injury, disease symptoms, and insect damage are recorded. Select data appears in this report. Annual summary reports have been prepared since 2006 and are available on request. 51 accessions of 37 different species are currently under evaluation at this site.

2014 Added Species and Rationale: On May 13, the following species were planted:

- 'Catskill' dwarf sand cherry *Prunus pumila* var. *depressa* L., accession 9051508 from Big Flats Plant Materials Center, Big Flats, New York. A non-invasive 1997 release with prostrate growth and immense root system. It grows well on gravelly or sandy soils along streams but has performed well on silt loam and calcareous soils. It is often used in shoreline and stream bank stabilization practices and riparian buffer plantings, where low vegetation is preferred, including areas with ice floe issues. Suggested adaptation is hardiness zones 3b to 6b.
- Swamp white oak, *Quercus bicolor* accession 9094441 (Illinois source) from Lawyer Nursery, Plains, Montana. This species is performing well at the Becker, Minnesota off-center location in extremely sandy soils.
- Gray birch *Betula populifolia*, accession 9094442 (Wisconsin source) from Lawyer Nursery, Plains, Montana; Row 6/6/1-5. Gray birch is performing well at the Becker, Minnesota offsite location in extremely sandy soils after many years. It will be interesting to see how it performs in this location with heavier clay loam soils. There is demand for a birch tree for conservation use, and this will be a good location to evaluate its performance.
- Lodgepole pine *Pinus contorta* var. *latifolia*, accession 9092231 (Mandan ARS source) from NDFS Nursery, Towner, ND; Row 7/1/1-5. Ponderosa pine is a tall straight-trunked, narrow-crowned pine, native to the Rocky Mountain and Cascade-Sierra Ranges. It prefers reasonably moist, well drained fertile soils, but has proven to be drought tolerant once it is established. It grows well in soil pH 5.0 to 7.5 and in Windbreak Suitability Groups 1, 3, 4, 5. Its tolerance to higher pH soils (up to pH 8.2) needs to be investigated. Lodgepole pine is used as a food source by a variety of birds, squirrels, and porcupine. This accession is a composite of five seed sources that scored well in tests at the Agricultural Research Station in Mandan for the past 30 years and at 2 North Dakota field locations for the past 7 years. In PMC trials, it exhibited darker green foliage than did ponderosa pine or Scotch pine. Early growth rates and foliage density were similar to ponderosa pine.

Current Evaluation:

On September 2, 2014:

- Information was collected on 27 entries. Crown spread and plant height were recorded along with observational notes relative to disease and insect damage, drought and cold tolerance, fruit production, survival, vigor, and predator damage.
- Most species exhibited good growth and survival. All species added in 2013 are doing quite well with the exception of the honeyberry (haskaps) varieties which appeared somewhat stunted.
- Fruit on the 'McKenzie' chokeberry was prevalent and harvested for seed.

Plant Performance: Records of planting date, survival, vigor, canopy width, height, cold hardiness, animal damage, insect damage, disease symptoms, and unusual or outstanding features have been maintained since 1978 and are listed in Table DI-2.

Maintenance is excellent. Table BE-2 provides detailed evaluation information on each tree or shrub in this planting. The following tables indicate individual species and varieties that are best adapted to the environment in this location:

Accessions currently performing well	
9082889 mugo pine	9082892 white poplar
9012606 creeping juniper	9091968 Kentucky coffeetree
9082887 seaberry	9078631 Rocky Mountain juniper
9082888 American hazel	9081843 ponderosa pine
9082891 common ninebark	9091971 black chokeberry
9082687 American black currant	9019593 common juniper
9082738 grey dogwood	9094281 Am. highbush cranberry
9091976 arrowwood viburnum	9047203 'Prairie Red' hybrid plum
9091971 black chokeberry	9092141 nannyberry
9008183 common chokecherry	9094333 common elderberry
323597 'McKenzie' black chokeberry	9094355 roughleaf dogwood
Recently planted accessions currently performing well	
9094356 Meyer spruce	9076737 black cherry
9094400 'Carmine Jewel' dwarf cherry	9094406 'Princeton' American elm
9094336 Freeman maple	9094417 Manchurian ash
9094416 sycamore	9094418 American hazel
9051508 'Catskill' sand cherry	9094442 gray birch

Figure BR-1. 2013 aerial photo at **Brookings, South Dakota Off-Center Evaluation Plots**

Figure BR-2. USDA-NRCS, Bismarck Plant Materials Center Tree and Shrub Evaluation Plots, Eastern South Dakota Soil and Water Research Farm, Brookings, SD

N ↓	Brookings OCEP Plot Map										
Row	1	2	3	4	5	6	7	8	9	10	11
S 1	Mugo pine (9082889)	Common ninebark (9082891)	Wayfaring bush (9082642)	Seaberry (9082887)	American hazelnut (9082888)	American currant (9082687)	Missouri gooseberry (9082746)	Gray dogwood (9082890)	Gray dogwood (9082738)	Roundleaf hawthorn (9076686)	Pin cherry (9091967)
S 2	Arrowwood viburnum (9091976)	Winterberry (9082711)	Shadblow serviceberry (9091975)	Chokeberry (9091971)	Chokecherry (9008183)	Russian peashrub (9091969)	Common juniper (9019593)	'Silverscape' olive hybrid (9092054)	Staghorn sumac (9092053)	Ironwood (9082739)	Skunkbush sumac (9091964)
S 3	Roughleaf dogwood (9094355)	horizontal juniper (9012606)	highbush cranberry (9094281)	'McKenzie' black chokeberry			'Prairie Red' plum	Nannyberry (9092141)	Elderberry (9094333)	Korean mountain ash (9092140)	
S 4	Meyer spruce (9094356)		Black cherry (9076737)		'Carmine Jewel' cherry (9094400)		Pie cherry (9092162)		Princeton elm (9094406)		'Berry Blue' haskap (9094419)
T 5	Freeman maple (9094336)		Littleleaf linden (9094335)		American linden (9094334)		White poplar (9082892)		Kentucky coffeetree (9091968)	'Cinderella' haskap (9094420)	
6	Manchurian Ash (9094417)		Sycamore (90944176)		American Hazel (9094418)	'Catskill' Sand cherry 9051508	Swamp white oak 9094441		Grey birch 9094442		
7	Lodgepole pine 9092231 #14070										
8											
T 9	Juniper (Bridger-Select)	Ponderosa pine (Hunter)									
SWCD 4	Prairie Harvest hackberry	'Oahe' hackberry	hackberry (9094282)								

Table No. BR-1: 2014 Weather Summary - Official Station - Brookings, South Dakota

	Mean Temperature (degrees Fahrenheit)		Precipitation (inches) Actual		Deviation from Normal
Month	**2014**	**Normal***	**2014**	**Normal***	**2013**
January	8.4	12.9	0.35	0.35	0.00
February	7.7	17.9	0.20	0.38	-0.18
March	23.9	29.9	1.02	1.22	-0.20
April	41.4	43.8	1.75	2.18	-0.43
May	55.2	56.0	2.06	2.97	-0.91
June	66.1	65.7	8.82	4.30	4.52
July	67.0	70.3	2.41	3.24	-0.83
August	68.1	68.1	2.90	3.06	-0.16
September	59.8	58.8	2.00	3.19	-1.19
October	48.1	45.6	0.66	2.05	-1.39
November	23.4	30.6	0.77	0.90	-0.13
December	22.4	16.7	1.03	0.42	0.61
Annual	**41.0**	**43.0**	**23.97**	**24.24**	**-0.29**

* National Climate Data Center 1981-2010 Monthly Normals

	2014
Last Frost (28 degrees)	16-May
First Frost (28 degrees)	10-Oct
Frost Free Period	146 days

Key to Table BR-2. 38I347K Field Evaluation of Woody Plant Materials – Brookings, South Dakota

PLOT LOCATION = plot location of the plant material within the evaluation
ACCESSION NUMBER = any accession number, PI number or cultivar name assigned to the plant material
PLANT SYMBOL = plant symbol of the genus and species (asterisk indicates the symbol is not official)
GENUS/SPECIES = common name and scientific name of the plant material
ORIGIN/SOURCE = origin and/or source of the plant material
TRANS DATE = month and day the plant material was transplanted at the evaluation site
YR PLT = year the plant materials were transplanted at the evaluation site
YR REC = year of record
MATL PLTD = type of material planted, PLBR = bareroot, CONT = containerized
NO PLTS = number of plants planted in the plot
NO SRV = number of plants surviving
PCT SRV = percent of plants surviving
VI = plant vigor (1=excellent, 3=good, 5=fair, 7=poor, 9=very poor)
CAN COV (ft) = canopy cover measured in feet
PLT HT (ft) = plant height measured in feet

Table BR-2.
Study No.: NDPMC-T-0201-CP, Field Evaluation of Woody Plant Materials, Brookings, SD
Year of Record: 2014

PLOT LOCATION	ACCESSION NUMBER	PLANT SYMBOL	GENUS/SPECIES ORIGIN/SOURCE	TRANS DATE	YR PLT	YR REC	MATL PLTD	NO PLTS	NO SRV	PCT SRV	VI	CAN COV (ft)	PLT HT (ft)	REMARKS
S1-1	9082889	PIMU80	mugo pine	18-May	04	04	PLBR	5	4	80	5	0.9	1.1	
			Pinus mugo			05			5	100	4	1.0	0.7	replant 3
			Big Sioux Nursery, Watertown, SD			06			5	100	3	1.4	0.8	1 open form
						08			5	100	3	2.5	2.1	
						10			5	100	3	4.4	3.5	
						13			5	100	1	6.7	6.0	
S1-2	9082891	PHOP	common ninebank	18-May	04	04	PLBR	5	6	100	2	1.4	1.9	
			Physocarpus opulifolius			05			6	100	2	3.7	3.5	
			Big Sioux Nursery, Watertown, SD			06			6	100	3	5.0	5.0	1 blight on leaves, 4 good seed
						08			6	100	3	7.5	5.9	light mildew, spot
						10			6	100	2	8.8	6.8	
						13			6	100	2	9.7	7.1	
S1-3	9082642	VILA	wayfaring bush	18-May	04	04	PLBR	5	5	100	3	0.7	1.2	
			Viburnum lantana			05			5	100	3	1.3	1.7	leaf burn on all
			Lincoln-Oakes Nursery, Bismarck, ND			06			5	100	3	2.0	2.6	
						08			5	100	4	3.4	4.3	highly variable
						10			5	100	5	4.8	5.2	red leaves 2
						13			5	100	5	3.0	3.8	1 all regrowth from base
S1-4	9082887	HIRH80	seaberry	18-May	04	04	PLBR	5	5	100	3	0.9	2.2	
			Hippophae rhamnoides			05			5	100	3	1.9	2.9	
			Lincoln-Oakes Nursery, Bismarck, ND			06			5	100	3	3.3	4.1	
						08			5	100	3	6.4	6.2	1-2 female, 3-5 male
						10			5	100		8.8	7.8	berries 1,2; 3-5 male
						13			5	100	3	8.6	9.0	
S1-5	9082888	COAM3	American hazelnut	18-May	04	04	PLBR	5	5	100	7	0.3	0.6	1 browsed off
			Corylus americana			05			5	100	5	0.6	0.7	leaf burn on all
			Lincoln-Oakes Nursery, Bismarck, ND			06			5	100	3	1.0	1.4	
						08			5	100	4	2.0	2.5	highly variable
						10			5	100	4	3.6	3.6	
						13			5	100	2	4.7	4.6	6-10" tip dieback 4

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S1-6	Riverview Germplasm	RIAM	American black currant	18-May	04	04	PLBR	5	5	100	2	1.2	1.8	
			Ribes americanum			05			5	100	3	4.0	2.6	mildew spot on all
	9082687		northeastern South Dakota			06			5	100	3	5.0	3.2	1,2 blight, leaf drop
			Bix Sioux Nursery, Watertown, SD			08			5	100	3	6.2	3.8	
						10			5	100	3	5.4	4.6	
						13			5	100	3	5.0	4.5	fungal disease on leaves
S1-7	9082746	RIMI	Missouri gooseberry	18-May	04	04	PLBR	5	5	100	3	1.8	1.7	
			Ribes missouriense			05			5	100	3	3.1	2.5	red fall color on all
			Big Sioux Nursery, Watertown, SD			06			5	100	3	3.8	3.3	3-5 some leaf drop, blight
						08			5	100	4	4.5	3.7	early leaf drop
						10			5	100	5	4.1	3.6	
						13			5	100	5	3.5	3.0	leaf disease all
S1-8	9082890	CORA6	gray dogwood	18-May	04	04	PLBR	5	5	100	4	0.8	1.3	3 browsed
			Cornus racemosa			05			5	100	3	1.4	1.9	leaf spot on 5
			Big Sioux Nursery, Watertown, SD			06			5	100	3	2.2	2.6	1,2,5 leaf spot
						08			5	100	4	3.8	3.9	highly variable; 4 very leafy
						10			5	100	3	4.2	4.6	
						13			5	100	4	4.8	5.3	
S1-9	9082738	CORA6	gray dogwood	18-May	04	04	PLBR	5	5	100	2	1.1	2.4	
			Cornus racemosa			05			5	100	3	1.9	2.8	leaf spot on 1 and 5
			Lincoln-Oakes Nursery, Bismarck, ND			06			5	100	2	3.4	3.8	1 bad leaf spot
						08			5	100	2	5.0	5.3	
						10			5	100	3	5.2	6.0	leaf spot on all
						13			5	100	2	5.9	6.5	lots of leaf spot
S1-10	9076686	CRCH	roundleaf hawthorn	18-May	04	04	PLBR	5	5	100	4	0.4	0.5	heavily browsed
			Crataegus chrysocarpa			05			4	80	4	0.7	1.3	browsed
			Lincoln-Oakes Nursery, Bismarck, ND			06			5	100	5	1.0	2.0	1 white aphid
						08			5	100	4	2.3	3.9	
						10			5	100	4	2.8	5.6	
						13			5	100	3	4.6	6.9	reduced width due to browsing

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S1-11	9091967	PRPE2	pin cherry	10-May	05	05		5	5	100	3	2.9	2.9	5 close spacing
			Prunus pensylvanica			06			5	100	3	4.2	4.1	4,5 leaf spot
			Big Sioux Nursery, Watertown, SD			07			5	100	3	4.3	5.0	
						09			5	100	5	7.8	7.1	deer rub 1,4; 5 close spacing
						11			3	60	6	5.8	6.5	
						14			5	60	5	3.5	3.2	
S2-1	9091976	VIDE	arrowwood viburnum	10-May	05	05		5	5	100	3	0.9	2.2	1 and 4 has fruit
			Viburnum dentatum			06			5	100	3	2.2	2.6	clean leaves, no disease
			Lincoln-Oakes Nursery, Bismarck, ND			07			5	100	3	3.1	3.3	no fruit
						09			5	100	3	4.9	5.0	1 clean leaves, some fruit
						11			5	100	3	5.8	5.7	
						14			5	100	2	6.8	7.0	
S2-2	9082711	EUBU6	winterberry	10-May	05	05		5	5	100	4	0.7	1.2	
			Euonymus bungeanus			06			5	100	4	1.1	1.5	
			Lincoln-Oakes Nursery, Bismarck, ND			07			5	100	4	2.1	2.7	
						09			5	100	4	4.7	3.9	
						11			5	100	5	5.1	3.9	
						14			5	100	2	4.4	4.2	
S2-3	9091975	AMLA9	serviceberry	10-May	05	05		5	5	100	4	0.9	1.9	leaves chewed on
			Amelanchier lamarckii			06			5	100	3	3.0	2.9	
			Lincoln-Oakes Nursery, Bismarck, ND			07			5	100	2	3.9	3.8	
						09			5	100	2	6.6	7.1	
						11			5	100	3	8.2	8.7	
						14			5	100	3	9.5	11.4	
S2-4	9091971	PHME13	black chokeberry	10-May	05	05		5	5	100	3	1.5	2.1	fruit on all
			Photinia melanocarpa			06			5	100	3	2.2	2.7	
			Bailey Nurseries, Inc.			07			5	100	2	2.7	3.3	
						09			5	100	3	4.7	4.6	
						11			5	100	3	5.5	5.9	
						14			5	100	3	6.2	6.9	

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S2-5	9008183	PRVI	common chokecherry	10-May	05	05		5	5	100	3	0.7	2.5	
			Prunus virginiana			06			5	100	3	2.0	4.0	shot hole on all
			Sheridan County, North Dakota			07			5	100	3	2.6	5.4	shot hole on all
			Lincoln-Oakes Nursery, Bismarck, ND			09			5	100	4	5.1	8.4	
						11			5	100	3	6.0	10.5	
						14			5	100	3	7.7	12.8	
S2-6	9091969	CAFR80	Russian peashrub	10-May	05	05		5	5	100	4	0.5	2.2	
			Caragana frutex			06			5	100	6	0.4	1.3	
			Big Sioux Nursery, Watertown, SD			07			5	100	6	0.5	1.5	deer browse on all
						09			5	100	4	1.2	2.4	1,2,5 browsed
						11			5	100	6	1.1	3.2	
						14			4	80	7	1.4	3.3	1,2 leaf mold
S2-7	9019593	JUCO6	common juniper	2-May	06	06	CONT	5	5	100	3	2.6	0.8	
			Juniperus communis			07			5	100	2	3.9	0.8	
			Wilton Mine, ND/McKenzie FEP, ND			08			5	100	2	5.8	1.5	
						10			5	100	3	8.0	2.3	
						12			5	100	2	9.0	2.5	
S2-8	9092054	ELAEA	Russian olive/silverberry hybrid	2-May	06	06	POTD	5	2	40	2	3.1	4.3	2,3,5 recently dead, canker?
	'Silverscape'		*Elaeagnus X* 'Jefmorg'			07			4	80	6	1.4	2.6	
			Lincoln-Oakes Nursery, Bismarck, ND			08			4	80	5	3.9	4.6	
						10			4	80	4	6.2	6.8	
						12			4	80	3	7.3	6.8	some (10%) dieback 1
S2-9	9092053	RHTY	staghorn sumac	2-May	06	06	PLBR	5	5	100	3	3.8	5.0	clean leaves, no disease
			Rhus typhina			07			5	100	5	4.8	6.2	
			Lincoln-Oakes Nursery, Bismarck, ND			08			5	100	3	8.9	8.9	
						10			5	100	5	8.2	8.8	
						12			5	100	2	4.3	5.9	

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S2-10	9082739	OSVI	ironwood	May	07	07		5	5	100		0.7	1.4	rabbit damage 1,5
			Ostrya virginiana			08			5	100	4	0.7	1.9	
			Sertoma Park, Bismarck, ND			09			5	100	4	1.7	2.3	
			USDA, NRCS, PMC, Bismarck, ND			11			5	100	6	2.3	2.8	
						13			5	100	5	4.1	5.1	
S2-11	9091964	RHTR	skunkbush sumac	May	07	07		5	5	100	3	0.8	1.3	
			Rhus trilobata			08			3	60	3	1.9	1.6	2,5 leafed and died; 4 weeping
			Cave Hills, SD			09			4	80	3	1.9	1.4	3 deer browse; 4 prostrate
			USDA, NRCS, PMC, Bismarck, ND			11			1	20	4	5.0	2.0	prostrate
						13			1	20	7	5.0	2.5	very tiny
S3-1	'Cathedral'	ULMUS	Siberian/Japanese elm cross	May	07	07		5	5	100	4	1.6	8.6	no leaves on 1
	9092142		*Ulmus X* 'Cathedral'			08			2	40		6.1	5.1	animal damage on all
			S& B Nursery, Bismarck, ND (Bailey's)			09			2	40		10.5	8.3	2,3 herb damage, multi-stems
						11				0				removed spring 2011
S3-1	9094355	CODR	roughleaf dogwood	5-May		11		5	5	100	3	0.9	2.2	
			Cornus drummondii			12			5	100	2	2.6	3.9	
			Big Sioux Nursery, Watertown, SD			13			5	100	2	4.3	5.1	4 leaf spot affecting 20% of area
S3-2	9012606	JUHO2	creeping juniper			08		5	5	100	3	2.1	0.4	
			Juniperus horizontalis			09			5	100	3	4.0	0.5	
			Golden Valley County, ND			10			5	100	2	4.5	0.5	
						12			5	100	2	5.0	0.5	
						14			5	100	2	5.0	0.8	
S3-3	9094281	VIOPA2	American highbush cranberry	7-May	09	09		5	5	100	3	1.6	2.0	
			Viburnum opulus var. *americanum*			10			5	100	4	2.5	3.2	
			Big Sioux Nursery, Watertown, SD			11			5	100	4	3.6	4.1	
						13			5	100	2	5.4	5.3	

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S3-4	'McKenzie'	PHME13	black chokeberry			08		5	5	100	2	2.8	2.5	
	323597		*Photinia melanocarpa*			09			5	100	2	4.2	3.7	all large fruit
			USDA, NRCS, PMC, Bismarck, ND			10			5	100	2	4.8	4.2	
						12			5	100	2	5.2	4.9	no fruit
						14			5	100	2	5.6	6.0	2 much fruit
S3-5	'Prairie Red'	PRUNU	hybrid plum			08		5	5	100	3	3.6	5.1	highly variable
	9047203		*Prunus* sp.			09			5	100	3	4.3	6.3	
			USDA, NRCS, PMC, Bismarck, ND			10			5	100	4	4.6	6.9	
						12			5	100	3	6.2	7.9	seed all gone, if any
						14			5	100	3	7.6	10.2	
S3-6	9092141	VILE	nannyberry	May	07	07		5	5	100	2	0.5	1.4	
			Viburnum lentago			08			4	80	2	1.0	3.0	
			Schumacher's, Heron Lake, MN			09			5	100	4	2.2	3.7	
						11			5	100	3	3.7	6.0	
						13			5	100	2	5.6	7.2	
S3-7	9094333	SANIC4	common elderberry			10		5	5	100	3	0.7	1.1	
			Sambucus nigra ssp. *canadensis*			11			5	100	4	2.1	3.5	
			Big Sioux Nursery, Watertown, SD			12			5	100	3	3.0	3.8	3,5 no seed, cupping on new leaves
						14			5	100	5	2.8	4.3	good fruit 2-5
S3-8	9092140	SOAL9	Korean mountain ash	May	07	07		5	5	100	6	0.4	1.2	rabbits 1,5; no leaves 1,4
			Sorbus alnifolia			08			2	40		0.9	1.5	
			Big Sioux Nursery, Watertown, SD			09			2	40	6	1.9	2.3	
						11			2	40	6	2.0	2.8	
						13			2	40	6	1.8	3.1	
4-1	9094356	PICEA	Meyer's spruce	5-May	11	11	CONT	5	5	100	3	1.1	1.3	
			Picea meyeri			12			5	100	2	1.2	1.3	
			Big Sioux Nursery, Watertown, SD			13			5	100	4	1.3	1.3	yellow apical

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4-2	9076737	PRSE2	black cherry	5-May	11	11	CONT	5	5	100	5	0.9	1.6	
			Prunus serotina			12			5	100	1	3.6	4.5	1 multi-stem; 40% leaf spot 2
			Big Sioux Nursery, Watertown, SD			13			5	100	3	6.5	6.6	1,3 multi-stem; 2,4 leaf spot
4-3	9094400	PRCE	dwarf cherry	7-May	12	12	PLBR	5	5	100	1	0.3	3.6	3' shelters & watered 5/8/12
	'Carmine Jewel'		*Prunus cerasus*			13			5	100	2		3.5	no browse, just topped shelters
			Big Sioux Nursery, Watertown, SD			14			5	100	2		3.7	browse on 1,2
4-4	9092162	PRUNU	pie cherry	7-May	12	12	PLBR	5	1	20	2	0.3	2.3	3' shelters & watered 5/8/12
			Prunus sp.			13			1	20	3		3.3	no browse
			Harding County, SD			14			1	20	3		3.4	
			USDA, NRCS, PMC, Bismarck, ND											
4-5	9094406	ULAM	American elm	7-May	12	12	PLBR	5	5	100	2	0.6	4.3	3' shelters
	'Princeton'		*Ulmus americana*			13			5	100	1		5.5	
			Schumacher's Nursery, Heron Lake, MN			14			5	100	3		6.2	removed tube 3-5
4-6	9094419	LOED	honeyberry (haskaps)	15-May	13	13	POTD	5	5	100	5	1.1	1.4	50% leaves blue/brown color
	'Berry Blue'		*Lonicera edulis*			14			5	100	3	1.7	2.1	
			Jeffries Nursery, Portage LaPrairie, MB											
5-1	9094336	ACFR	Freeman maple	6-May	10	10	PLBR	5	5	100	3	0.5	1.5	
			Acer x freemanii			11			5	100	4	3.0	4.2	
			Big Sioux Nursery, Watertown, SD			12			4	80	2	5.4	6.5	all multi-stemmed
						13			5	100	4	6.8	7.6	
5-2	9094334	TIAM	American linden	6-May	10	10	PLBR	5	5	100	3	1.1	1.8	
			Tilia americana			11			5	100	6	1.0	1.6	
			Big Sioux Nursery, Watertown, SD			12			5	100	1	3.3	3.5	all multi-stemmed
						14			5	100	4	5.5	5.5	
5-3	9094335	TICO2	littleleaf linden	6-May	10	10	PLBR	5	5	100	5	0.5	1.0	tip dieback on 1
			Tilia cordata			11			5	100	5	2.3	2.8	
			Big Sioux Nursery, Watertown, SD			12			5	100	4	2.4	3.6	leaf rust 1,2,5; severe rust 4
						14			5	100	4	3.8	4.8	

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5-4	9082892	POAL7	white poplar	6-May	10	10	PLBR	5	5	100	3	1.9	3.4	
			Populus alba			11			5	100		7.1	6.9	
			Big Sioux Nursery, Watertown, SD			12			5	100	1	9.9	8.3	many basal and root sprouts
						14			5	100	2	18.0	14.6	very invasive, spreading to other plots
5-5	9091968	GYDI	Kentucky coffeetree	5-May	11	11	PLBR	5	5	100		0.6	0.7	
			Gymnocladus dioicus			12			4	80		1.1	1.1	weed competition
			Big Sioux Nursery, Watertown, SD			13			5	100	2		2.4	5-ft tubes; leaves all bunched
						14								tubes removed 1,5
5-6	'Cinderella'	LOED	honeyberry (haskaps)	15-May	13	13		5	4	80	7	0.9	0.9	appeard to have no new growth
	9094420		*Lonicera edulis*			14			5	100	5	1.3	1.2	
			Jeffries Nursery, Portage La Prairie, MB											
6-1	9094417	FRMA	Manchurian ash	15-May	13	13		5	5	100	2		3.6	5-ft tubes
			Fraxinus mandshurica			14			5	100	2		6.2	
			China											
			Big Sioux Nursery, Watertown, SD											
6-2	9094416	PLOC	sycamore	15-May	13	13		5	5	100	1		4.8	5-ft tubes
			Platanus occidentalis			14			5	100	1		7.9	
			Lincoln-Oakes Nursery, Bismarck, ND											
6-3	9094418	COAM	American hazel	15-May	13	13		5	5	100	2	0.8	1.7	
			Corylus americana			14			5	100	3	1.7	2.2	
			northern Minnesota											
			Big Sioux Nursery, Watertown, SD											
6-4	'Catskill'	PRPUD	sandcherry	12-May	14	14	PLBR	5	5	100	2	4.1	1.3	
	9051508		*Prunus pumila* var. *depressa*											
			Big Flats PMC, Corning, NY											

Study No.: NDPMC-T-0201-CP, Field Evaluation of Woody Plant Materials, Brookings, SD
Year of Record: 2014

PLOT LOCATION	ACCESSION NUMBER	PLANT SYMBOL	GENUS/SPECIES ORIGIN/SOURCE	TRANS DATE	YR PLT	YR REC	MATL PLTD	NO PLTS	NO SRV	PCT SRV	VI	CAN COV (ft)	PLT HT (ft)	REMARKS
6-5	9094441	QUBI	swamp white oak *Quercus bicolor* Illinois Lawyer Nursery, Plains, MT	12-May	14	14	PLBR	5	5	100	3		2.6	tubes are too tall
7-1	9092231	PICO	lodgepole pine *Pinus contorta* USDA-ARS, Mandan, ND ND Forest Service Nursery, Towner, ND	12-May	14	14	PLBR	5	3	60	5		0.5	poor stock; need to be replanted
T2-1	'Bridger-Select' 9078631	JUSC2	Rocky Mountain juniper *Juniperus scopulorum* USDA, NRCS, Bridger, MT	10-May	05	05		5	5	100	2	0.8	1.5	good color
						06			5	100	2	1.5	2.8	
						07			4	80	2	1.9	3.2	
						09			4	80	4	3.1	4.5	
						11			4	80	3	4.1	5.9	
						14			4	80	5	5.6	7.8	
T2-2	Hunter Germplasm 9081843	PIPO	ponderosa pine *Pinus ponderosa* USDA, NRCS, Bridger, MT	10-May	05	05		5	5	100	3	0.6	1.2	
						06			5	100	2	1.3	1.8	
						07			5	100	2	1.6	2.1	
						09			5	100	3	3.1	4.2	
						11			5	100	4	5.0	6.7	
Row 4	9094282	CEOC	hackberrry *Celtis occidentalis* South Dakota source Big Sioux Nursery, Watertown, SD	8-May	09	09		4	4	100	4		3.8	in Tubex
						10			4	100	3		5.6	in Tubex
						11			4	100	3	4.1	7.2	
						13			4	80	3	5.3	8.7	some dieback 3
Row 4	'Oahe'	CEOC	hackberrry *Celtis occidentalis* Big Sioux Nursery, Watertown, SD	8-May	09	09		5	5	100	3		3.0	in Tubex
						10			5	100	3		5.4	
						11			5	100	4	4.8	7.0	
						13			5	100	4	5.4	8.5	fungal disease on 10% leaves

Study No.: NDPMC-T-0201-CP, Field Evaluation of Woody Plant Materials, Brookings, SD
Year of Record: 2014

PLOT LOCATION	ACCESSION NUMBER	PLANT SYMBOL	GENUS/SPECIES ORIGIN/SOURCE	TRANS DATE	YR PLT	YR REC	MATL PLTD	NO PLTS	NO SRV	PCT SRV	VI	CAN COV (ft)	PLT HT (ft)	REMARKS
Row 4	Prairie Harvest	CEOC	hackberrry	8-May	09	09		5	5	100	3		3.5	in Tubex
	Germplasm		*Celtis occidentalis*			10			4	80	3		4.8	
	9034956		Polk County, MN			11			5	100	4	2.5	5.7	1-replant
	ND-3878					13			4	80	3		4.8	

OFF-CENTER EVALUATION PLANTING: TECHNICAL REPORT 2014

Study NDPMC-P-1001-WI Lodgepole Pine Evaluation

Study Title: Field Evaluation of Woody Plant Materials

Objective: Evaluate various selected seed sources of lodgepole pine in both replicated and non-replicated field trials in western North and South Dakota. Data collection will document both species performance in windbreaks and seed source differences.

Introduction**:** Lodgepole pine (*Pinus contorta* var. *latifolia*) is a native conifer species known for its long, slender trunk and high, thin crown. It grows on a wide variety of soils but does best on medium-textured soils derived from coarse parent materials. Lodgepole pine may have potential as an additional tall tree species for conservation use in the western parts of North and South Dakota.

Cooperators: The USDA Natural Resources Conservation Services, Plant Materials Center (PMC), Bismarck, North Dakota, in cooperation with NRCS field offices located at Dickinson and Hettinger, ND, and Hot Springs, SD; Lake Angostura State Park, SD; NDSU Hettinger Research Extension Center (HREC), ND; and the Flying O Ranch near Hebron, ND.

Location: Flying O Ranch, NW1/4, sec. 3, T140N, R91W, Hebron, ND (non-replicated); Hettinger Research and Extension Center, Sec. 14, T129N, R96W, Hettinger, ND (replicated); and, Angostura State Park, Sec. 28, T8S, R6E, Hot Springs, SD (replicated).

Major Land Resource Area (MLRA): The sites are located in MLRA 54, the Rolling Soft Shale Plain; and MLRA 61, the Black Hills Foot Slopes.

Soils: The Hebron site is a fine sandy loam. The Hettinger site is an Arnegard silt loam, and the Hot Springs planting is on a Savo silt loam.

Climate: The average annual precipitation for MLRA 54 is 12 to 17 inches with an average freeze-free period of 110 to 135 days. The average annual precipitation for MLRA 61 is 15 to 18 inches with an average freeze-free period of 110 to 140 days.

Methods and Materials

Assembly: Cones were collected from superior trees (Table LP-1) in 2012 in a provenance study at the Agricultural Research Service, Northern Great Plains Research Lab at Mandan, North Dakota. Cones were processed at the Bismarck PMC and the seed was separated. Towner State Nursery (TSN) grew out seedlings of each source and provided them for the study.

Table LP-1. Selected Seed Sources

Accession	Origin	Seedlings
14107(107)	British Columbia (Jacobie Creek)	500+
14108(108)	British Columbia (Lac le Jeune)	45
14109(109)	British Columbia (Clearwater)	400
14070 (070)	Colorado (Routt National Forest - Salida)	100
13351-10 (1-10)	Montana (Beaverhead National Forest – Dillon)	125
14105 (105)	Saskatchewan (Cypress Hills Provincial Park)	75
MP-718	Mongolian Scotch Pine	PMC
MP-158	Mongolian Scotch Pine	PMC
PP	Ponderosa Pine	TSN

Planting Plan:
Replicated (2 sites) – One site each in western North Dakota (Hettinger REC) and South Dakota (Angostura State Park). Total number of trees at each site equals 3-plant plots x 5 randomized replications x 8 seed sources = 120 trees at each site, 15 of each accession. Accession MP-718 (Mongolian pine) was included as part of the replicated study. Ponderosa pine was included as a standard of comparison.
Non-replicated (1 site) – The one non-replicated site in western North Dakota near Hebron had 5-plant plots for each entry. Accession 108 was not included due to stock shortages. Ten entries of accession 109 were included as a substitute for the missing accession 108. Ponderosa pine was used as a standard of comparison. A total of 40 trees were planted.

Plot Preparation: All three sites were cultivated. The Hebron site is near an existing windbreak by a farmstead. The trees were hand planted into weed barrier fabric. The Hettinger site is cropland on the outside of a deteriorating windbreak. The trees were hand planted into weed barrier fabric, and six-foot diameter by five-foot tall wire cages were placed around the trees to protect from deer. The area between the fabric strips was seeded to blue grama. The Angostura site is part of a recreation area. Trees were planted into six-foot wide bands of well tilled soil and 3-foot fabric squares were placed around trees after planting.

Planting Dates: All plots were planted in the spring of 2008. The Hebron site was planted on May 16; the Hettinger site on May 12; and the Angostura site on May 14.

Irrigation: The trees are not irrigated.

Evaluations and Measurements:
2008: Survival, vigor ratings, and height measurements were taken the end of the growing season in 2008. See Tables LP-2 (Hebron), LP-5 (Hettinger), and LP-8 (Angostura) for 2008 evaluation data. Initial survival was greater than 80% at all sites. Vigor ratings were in the average range (3-5), and height averaged approximately .75 to 1 foot. Trees at Angostura State Park were browsed repeatedly by deer and killed during the fall and winter 2008/9. Approximately 75% of the lodgepole pines were damaged and 50% of the ponderosa pines.

2009: Replacements at Angostura State Park were planted on May 15, 2009, in the first three replications. Most of the trees replanted in replications four and five were ponderosa pine. Animal repellant was sprayed on all the trees after replanting. Cages were later installed on the first three replications (southwest two rows). See Table LP-3 for 2009-2010 data collected at the Hebron site and Table LP-6 for 2009-2010 data collected at the Hettinger site. See Table LP-9 for 2009 data collected at Angostura State Park.

2010: Dead and missing plants in the spring were replanted at all sites to either Mongolian pine or ponderosa pine. Many of the plants at Hettinger had a major flush of annual weed growth in the hole of the fabric and on the edge. The heaviest infestations were removed, and granular Preen (triflurilan) was applied and incorporated by hand. Replacements at Angostura State Park were planted in early June. Rainfall conditions were again good to excellent at the three sites. Dense growth of Russian thistle again provided protection from deer at Hebron. Overall, the plants were not vigorous at Angostura State Park, and the 3-foot fabric squares may not provide adequate weed control in the sod. See Table LP-3 for 2009-2010 data collected at the Hebron site; Table LP-6 for 2009-2010 data collected at the Hettinger site; and Table LP-10 for 2010 data collected at Angostura State Park near Hot Springs, SD.

2011: Evaluations were completed. There was very good survival at Hettinger. The one time application of Preen was quite effective. Some Siberian elms have become established in the fabric openings. Grass that was seeded between fabric strips continues to be sparse, but the research center is controlling weeds effectively with mowing. No evaluations were conducted at Hebron. Tree growth rates and vigor continue to decline at Angostura. Brome has regrown to fabric edges. The dense clay subsoil often found within the Savo map unit may greatly hinder coniferous tree survival and growth, especially if the 3-foot fabric squares are providing limited to no weed control benefits to the trees. Note: After the trees were planted and fabric squares installed, we became aware of several weed control studies indicating that weed control of less than 6-foot square around individual trees was no more effective than the controls in the study with no weed control. Plants where water can apparently pond are not doing well. Deer continue to decimate trees not protected with wire cages. See Table LP-4 for 2011-2012 data collected

at the Hebron site; Table LP-7 for 2011-2012 data collected at the Hettinger site; and Table LP-11 for 2011-2012 data collected at Angostura State Park near Hot Springs, SD.

2012: This was a dry year at all three sites. Angostura was experiencing severe drought. Trees at Angostura continued to die. Dense brome was growing at edges of fabric squares and from many of the fabric openings. Some accessions have died completely. The Angostura location supports other research findings that 3-foot fabric squares do not provide adequate weed control. Russian thistle had diminished at the Hebron site, replaced by dense stands of brome. Brome formed robust contiguous bands along the edges of the fabric and from many of the fabric openings at the Hebron site. It appears the dense brome has hindered tree growth, resulting in the death of some.

The planting at Hettinger is doing well. No additional mortality. Good growth on all. Factors favoring these good results include good weed control with the fabric, good weed control between the rows with the blue grama and mowing, and the fact of being planted on one of the better soils in the region. At evaluation time, the lodgepole pine exhibited a very dark green color. The ponderosa pine showed a green/grey color cast while the Mongolian Scots pine exhibited a yellow/green cast. Similar to what is found in the wild and what was observed at the ARS provenance test, 5-10 of the lodgepole pine at Hettinger showed tip damage from *Petrova luculentana* (pine pitch nodule maker). Unless this insect damages an apical tip it should have minimal impact on the planting.

See Table LP-4 for 2011-2012 data collected at the Hebron site; Table LP-7 for 2011-2012 data collected at the Hettinger site; and Table LP-11 for 2011-2012 data collected at Angostura State Park near Hot Springs, SD. For a graphical summary of the findings after five years, refer to Figures LP-1 through LP-4. For more specific details on overall heights, vigor, and survival, refer to Tables LP-2 through LP-11. Similar to findings in other studies, five years of data show that Scots pine grows the fastest, with survival rates similar to ponderosa pine. Both the lodgepole pine and the ponderosa grow at about the same rate, but lodgepole pine has a bit less survival percentage and is less able to exist with dense sod weed pressure.

2013: No on-site visits were made. Extensive inventory and analysis of findings will be conducted in 2014.
Note: The provenance test at ARS, source of the seeds for the three test locations above, is being converted into a seed orchard by ARS and PMC staff. Plans are to thin the stand to about 65 square feet basal area and prune the mostly dead limbs to 8' height above the ground. The thinning scheme calls for every seed tree left to have at least one blank (missing tree) adjacent, to provide more water and nutrients and reduce stress. The thinning and especially the pruning, will make the stand more resistant to stand killing fires. The four lowest-scoring accessions will be removed, leaving 21 accessions to be used as a composite seed orchard. Disposal of pruning and thinning debris is the biggest issue as the debris cannot be stacked onsite due to fire and Ips beetle risk, and the ARS station does not want to burn the debris, so debris will be chipped and/or shipped to the Mandan landfill for burial. Once thinned and pruned the stand will be more accessible for bucket truck maneuvering and mowing or chemical control of sod and weeds.

2014: 545 lodgepole pine seedlings, grown from seeds collected at ARS were provided to 21 field offices for field plantings in Minnesota, South Dakota, and North Dakota.

There was no site visit to the Hebron site, and a brief visit of the Hettinger site indicated that it was doing well. The Angostura site was visited with a representative of the South Dakota Division of Forestry. The entire Angostura study site has been destroyed as part of sewer installation. Only one or two trees of the first three replications were still alive and growing. Wire cages, fabric, and other trees were gone with only bare soil remaining. The study site at the Angostura location is terminated.

Extensive inventory and analysis of findings from the Hettinger and Hebron sites will be conducted in 2015. After analysis of the 2015 data, the study should be complete until the evaluation data from field plantings is completed.

The following history includes PMC and partner activities in 2014 as the 1980 provenance study was converted to a seed orchard.

Short history of ARS (Northern Great Plains Research Laboratory) lodge pole pine planting.
This is a 30-year study that has shown most lodgepole pine accessions in the study are climatically adapted to this part of the state. This ARS provenance test converted into a seed orchard is the seed source for PMC evaluations of

lodgepole pine as well as all stock for field plantings in 3 states. The following gives a history of the stand, PMC inputs and future hopes for the progeny. We continue to work closely with ARS on several promising species that are producing seed. Utilizing selected provenances from ARS test material can potentially save decades of PMC study and possibly result in a tall tree species release adapted to the Great Plains. Since the founding of the Northern Great Plains Research Laboratory (ARS) in 1913, a very strong emphasis in developing conservation trees for the Northern Great Plains has existed. Details specific to the lodgepole pine study follow:

- 1980: Lodgepole pine seed source trial was established.
- 1995: Lodgepole trees were scored and accessions evaluated by ARS.
- 2005: Natural Resources Conservation Service, Plant Material Center (PMC) collected cones and cleaned seed from 12 accessions, most of which appeared more robust, taller and with denser foliage. A high proportion of the PMC collected seeds came from trees that had also scored high in the 1995 evaluation.
- 2005: Towner State Nursery grew seedlings from collected seed.
- 2006: PMC established trials with the above material at Hettinger, North Dakota; Hebron, North Dakota and Angostura State Park, South Dakota.
- 2012: Trials from 2006 looked good. PMC staff collected more seed.
- 2012: PMC staff pruned 2 lanes for bucket truck access to allow more efficient seed harvest.
- 2013: Towner State Nursery grew seedlings from harvested and cleaned seed.
- 2014: Seedlings shipped to multiple sites in 3 states for on-farm field planting trials.
- 2014: August – worked with multiple agencies to develop lodgepole pine stand management plan.
    - Stand was at high risk of replacement wild fire.
    - Stand was overstocked, about 2 times the trees that could be supported by the site.
    - No access for harvest or weed control.
- 2014: October – PMC staff marked seed trees and continued pruning and stacking limbs.
- 2014: November - PMC and North Dakota Forest Service (NDFS) staff finished pruning and thinned surplus trees. ARS provided dumpsters and staff with loader to pack dumpsters.
- 2015: January - PMC staff attached aluminum tag identification to seed trees.
-

<u>By the numbers</u>

- 80% of the 4 lowest scoring accessions had died by Nov 2014. (Only 16 out of 80 trees remained.) This left 221 trees from 21 seed sources ranging from 6-14 trees per seed source.
- Released 221 seed trees; 1.47 acres if seed trees with average basal area of 69.9 sq. ft.
- Removed 120 live trees.
- Removed 15 dead trees.
- Pruned 11,000 limbs from 293 trees (seed trees and border trees) mostly with hand saws, some with power pole pruners.
- 19 individuals from 7 different agencies and the private sector provided 208 hours of on-the-ground assistance.
- Estimated 100 hours of office prep and machinery transport.
- Burleigh County SCD provided hydraulic saw.
- A private individual provided a power pole pruner and cordless impact driver.
- NDFS provided power pole pruner and 4 staff for 2 days.
- PMC provided 2 skid loaders, trucks, trailers, pruning saws, aluminum tags, and 2-3 staff for more than 4 weeks in November.
- ARS funded dumpsters and provided identification tags and mounting screws, staff person and payloader to pack dumpsters.
- Since 2012, there have been PMC staff (including summer staff and NRCS details) assisting in the pruning.
- NDFS and North Dakota State University (NDSU) have provided on the ground planning assistance and offsite technical assistance.
- USFS west region research geneticist provided invaluable assistance designing the thinning scheme and future management options.

<u>Results and future suggestions</u>

- Stand is nearly at the desired basal area for the site. (Some areas are less than desired because of earlier mortality. Some are slightly over because of random placement of surviving trees of desired seed sources.

- Removal of ladder fuels should reduce the risk of stand-replacing wildfires. For best fire management, the grass within and adjacent to the stand should be kept short at times when fire danger is increased.
- Thinning of the tree canopy will allow the smooth brome to grow more robust, which will increase stress to trees. Mowing more frequently may reduce stress along with fire danger.
- Thistle and wormwood patches are now accessible for treatment.
- Killing vegetation in 10-foot squares around each tree would greatly benefit the tree without exposing the site to erosion.
- Grazing within a prescribed grazing plan, might be another way to reduce stress from grass and to reduce fire danger. The stand would be an appropriate site for silvopasture management. Close observation of grazing animals would be necessary to prevent tree and root collar damage.
- The last few years have been very stressful to the trees as evidenced by the high mortality and the numerous misshapen unfilled cones.
- Since the PMC trials using seed from this stand have proven promising, the PMC efforts to convert this stand (not on PMC property) to a seed orchard were justified. PMC staff became involved 30 years after stand establishment, thus the very expensive startup costs were avoided. Within 5-10 years PMC field plantings using this material should indicate if the species is ready to be added to the North Dakota, South Dakota and Minnesota Field Office Technical Guides as an approved conservation species.
- For the immediate future, PMC will aggregate harvested seeds and process all material as one seed lot. This should provide a broad genetic basis for planted trees. Without extensive genetic protocols, (bagging female flowers before pollination, etc.), the best one can hope for genetically from each tree is a half sib offspring, though many may have been self-pollinated.
- The individual tree identification were for future personnel who may need to know the genetics of each individual tree.
- If time allows and equipment is adequate, GPS coordinates of each tree could be recorded as another means of individual tree identification.

The NRCS Plant Materials Center staff appreciates all who made this possible, with equipment, personnel, technical assistance, and financial backing. The conservation nurseries of the Northern Great Plains now have a source of a potentially superior seed of a tall tree species.

Table LP- 2. Lodgepole pine evaluation study, planted in 2008 near Hebron, North Dakota. Data collected 8/24/2008.

Thin diagonal stripe means dead plant at 2008 evaluation.

Accession	Plant No.	Survival	Vigor 1= best 9 =worst	Height (ft)	Remarks
70	1	x	4.00	1.00	
70	2	x	4.00	1.00	
70	3	x	3.00	0.75	
70	4	x	3.00	1.00	
70	5	x	3.00	1.00	
105	1	x	4.00	0.75	
105	2	x	3.00	0.50	
105	3	x	3.00	0.50	
105	4	x	3.00	0.50	
105	5	x	5.00	0.50	
PP	1	x	4.00	1.00	
PP	2	dead	9.00		
PP	3	x	4.00	0.75	
PP	4	x	3.00	0.75	
PP	5	x	3.00	0.75	
107	1	x	3.00	0.75	
107	2	dead	9.00		
107	3	x	4.00	1.00	
107	4	x	4.00	1.00	
107	5	dead	9.00		
MP-158	1	x	3.00	1.00	
MP-158	2	x	3.00	1.00	
MP-158	3	x	4.00	1.25	terminal bud browsed
MP-158	4	x	3.00	1.25	
MP-158	5	x	3.00	1.25	
109	1	x	3.00	0.75	
109	2	x	5.00	0.75	
109	3	x	3.00	0.75	
109	4	x	6.00	0.50	browsed
109	5	x	8.00	0.50	
109	6	x	3.00	0.75	
109	7	x	4.00	0.50	buds gone
109	8	dead	9.00		
109	9	x	3.00	0.50	
109	10	x	3.00	0.50	
1(10)	1	x	3.00	1.00	
1(10)	2	dead	9.00		
1(10)	3	x	3.00	1.00	
1(10)	4	x	2.00	1.00	
1(10)	5	x	3.00	1.00	

Table LP-3. Lodgepole pine evaluation study, planted in 2008 near Hebron, North Dakota. Data was collected on September 23, 2009, and September 26, 2010.

Accession No.	Plant No.	Survival	Vigor (1=highest, 9=poorest) 2009	Vigor (1=highest, 9=poorest) 2010	Height (ft) 2009	Height (ft) 2010	Remarks (2009)
70	1	x	3	2	1.00	1.75	
	2	x	3	2	1.50	1.75	
	3	x	3	3	1.00	1.25	
	4	x	3	4	1.50	1.25	
	5	x	3	5	1.00	1.25	
105	1	x	4	2	0.75	1.25	
	2	x	4	2	0.75	1.50	
	3	x	3	2	0.75	1.00	
	4	x	3	2	1.00	1.25	
	5	x	5	5	0.50	0.50	browsed
PP	1	x	3	2	1.75	2.50	
	2	x	3	9	1.00	0.00	
	3	x	3	3	1.00	1.50	
	4	x	4	9	1.00	0.00	
	5	x	3	2	1.25	1.25	
107	1	x	4	2	1.75	2.00	browsed
	2	x	3	9	1.75	1.25	
	3	x	3	3	1.25	1.25	
	4	x	5	3	1.00	1.00	
	5	x	4	1	1.50	2.00	
MP-158	1	x	3	3	1.25	1.50	
	2	x	3	2	1.25	2.00	
	3	x	2	1	1.75	3.25	
	4	x	2	1	1.75	2.25	
	5	x	2	2	1.75	1.75	
109	1	x	3	9	1.50	0.00	
	2	x	2	2	1.50	2.00	
	3	x	4	3	0.75	1.25	
	4	dead	NA	NA	NA	NA	
	5	dead	NA	NA	NA	NA	
	6	x	3	2	1.00	2.00	
	7	x	3	9	0.75	0.00	
	8	x	3	3	1.50	1.25	
	9	x	4	1	1.00	2.25	
	10	x	4	1	1.00	2.00	
1(10)	1	x	4	4	1.75	1.00	
	2	x	4	9	1.75	0.00	
	3	x	2	2	1.75	2.25	browsed
	4	x	3	4	1.50	1.25	
	5	x	4	4	0.75	0.75	

LP-4. Lodgepole pine evaluation study near Hebron, North Dakota. Evaluated 10/16/2012.

Thin diagonal stripe means replanted to original accession, spring 2009.

Vigor rating: 1-9; 1=best, 9=poorest

Accession	Plant #	Vigor rating	Height (ft)	Width (ft)	Notes
070	1	2	2.5	1	
070	2	1	2.25	1.25	
070	3	1	2.5	2.25	
070	4	9			dead at 2' tall
070	5	6	1	0.5	dense brome and browse
105	1	4	1	0.5	
105	2	2	2	2.25	
105	3	1	2.25	1.5	
105	4	3	1.25	1.25	
105	5	9			dead, small needles still on
PP	1	2	2.75	2	
PP	2	9			dead
PP	3	9			dead
PP	4	9			dead
PP	5	2	3	1.75	
107	1	2	3.25	1.5	
107	2	9			dead
107	3	1	3.25	1.75	
107	4	9			dead
107	5	3	2	0.5	
MP 158	1	4	2.5	3	yellow needle tips
MP 158	2	3	4.5	3	
MP 158	3	3	3.25	2.5	double leader
MP 158	4	3	4	3.5	short needles, open canopy
MP 158	5	3	4.25	3.5	
109	1	9			dead
109	2	2	2.25	2.25	
109	3	9			dead
109	4	9			dead
109	5	9			dead
109	6	2	3.25	3	
109	7	9			dead
109	8	2	2	1.75	double leader
109	9	2	4.75	2.25	
109	10	2	4.5	3	
1-10	1	3	1.5	1.25	
1-10	2	9			dead
1-10	3	3	1.75	1.25	
1-10	4	9			dead
1-10	5	3	2	1	

There appears to be a strong correlation between dense weeds in the opening and reduced vigor and height. Dense weeds and sod are found in most all openings and along fabric edges. There is a hard-to penetrate soil layer at 3" depth.

Table LP-5. Lodgepole pine evaluation (replicated) near Hettinger, North Dakota. Data taken on 09/24/2008.
Thin diagonal stripe means dead plant at 2008 evaluation.

Rep	Accession	Plant #	Survived	Vigor (1-9) 1=best	Height (ft)	Remarks
1	70	1	x	3	1.25	
1	70	2	x	3	1.00	
1	70	3	x	2	1.00	
1	105	1	x	3	1.25	floppy
1	105	2	x	4	1.00	droopy needles
1	105	3	x	3	1.00	
1	108	1	x	4	0.75	
1	108	2	x	2	1.25	
1	108	3	x	3	1.00	
1	PP	1	x	4	1.00	big Russian thistle
1	PP	2	x	2	1.00	R. thistle and S. elm
1	PP	3	x	3	1.00	
1	107	1	x	3	1.25	
1	107	2	x	3	1.25	
1	107	3	x	2	1.50	
1	MP-718	1	x	4	1.25	
1	MP-718	2	x	3	1.25	
1	MP-718	3	x	3	1.25	
1	109	1	dead			
1	109	2	x	3	1.00	
1	109	3	x	3	1.00	
1	1(10)	1	x	3	1.25	
1	1(10)	2	x	3	1.25	
1	1-10	3	x	4	1.00	
2	70	1	x	3	1.00	
2	70	2	x	3	1.00	
2	70	3	x	3	1.00	
2	105	1	x	2	1.25	
2	105	2	x	3	1.25	
2	105	3	x	4	1.00	
2	108	1	x	3	1.25	
2	108	2	x	4	0.75	
2	108	3	x	4	0.75	
2	PP	1	x	3	1.00	
2	PP	2	x	3	1.00	
2	PP	3	x	4	1.00	
2	107	1	x	3	1.25	
2	107	2	dead			
2	107	3	x	3	1.25	
2	MP-718	1	x	3	0.75	
2	MP-718	2	x	4	1.00	
2	MP-718	3	x	4	1.00	
2	109	1	x	3	1.00	
2	109	2	x	2	1.25	floppy
2	109	3	x	3	1.25	
2	1(10)	1	x	3	1.75	
2	1(10)	2	x	3	1.25	
2	1(10)	3	x	4	1.50	

Rep	Accession	Plant #	Survived	Vigor (1-9) 1=best	Height (ft)	Remarks
3	70	1	x	4	1.25	
3	70	2	x	3	1.25	
3	70	3	x	4	1.00	
3	105	1	x	4	1.00	
3	105	2	dead			
3	105	3	x	4	1.00	Siberian elm seedlings
3	108	1	x	3	0.75	
3	108	2	x	3	1.00	
3	108	3	x	6	0.75	bud gone
3	PP	1	x	4	1.00	
3	PP	2	x	3	0.75	
3	PP	3	x	5	0.75	big Russian thistle
3	107	1	x	4	1.00	top dieback
3	107	2	x	3	1.25	
3	107	3	x	3	1.25	weeds in fabric opening
3	MP-718	1	x	4	1.25	big pigweed
3	MP-718	2	x	2	1.25	Russian thistles
3	MP-718	3	x	3	1.00	
3	109	1	x	6	0.75	
3	109	2	x	4	0.75	
3	109	3	dead			
3	1(10)	1	x	5	1.00	
3	1(10)	2	x	4	1.25	
3	1(10)	3	x	3	1.00	
4	70	1	x	3	1.00	
4	70	2	x	3	0.75	
4	70	3	x	3	1.25	
4	105	1	x	3	1.00	
4	105	2	x	3	1.25	
4	105	3	x	3	1.50	
4	108	1	x	3	0.75	
4	108	2	x	3	0.75	
4	108	3	x	3	0.75	
4	PP	1	x	3	0.75	big weed
4	PP	2	x	3	1.00	
4	PP	3	x	3	1.00	
4	MP-718	1	x	3	1.50	
4	MP-718	2	x	4	1.25	
4	MP-718	3	x	3	1.75	
4	107	1	x	4	1.50	
4	107	2	x	4	1.25	
4	107	3	x	4	1.25	
4	109	1	x	3	1.00	
4	109	2	dead			
4	109	3	x	3	1.00	
4	1(10)	1	x	3	1.25	
4	1(10)	2	x	3	1.00	
4	1(10)	3	x	3	1.00	
5	70	1	x	4	1.00	
5	70	2	x	3	1.00	
5	70	3	x	3	1.00	

Rep	Accession	Plant #	Survived	Vigor (1-9) 1=best	Height (ft)	Remarks
5	105	1	x	3	1.00	
5	105	2	x	2	1.00	
5	105	3	x	3	1.00	
5	108	1	x	3	0.75	
5	108	2	x	4	0.75	
5	108	3	x	3	1.00	
5	PP	1	x	3	1.00	big Russian thistle
5	PP	2	x	3	1.00	
5	PP	3	x	5	0.75	
5	107	1	x	3	1.25	
5	107	2	dead			
5	107	3	x	3	1.25	
5	MP-718	1	x	3	1.25	
5	MP-718	2	x	3	1.25	
5	MP-718	3	x	3	1.25	
5	109	1	dead			
5	109	2	x	3	1.00	
5	109	3	x	3	0.75	
5	1(10)	1	x	3	0.75	
5	1(10)	2	dead			
5	1(10)	3	dead			

Table LP-6. Lodgepole pine evaluation (replicated) near Hettinger, North Dakota. Data was collected on September 23, 2009, and September 27, 2010. Replants in 2010 are of different sources.

Accession No.	Plant No.	Survival	Vigor (1=highest, 9=poorest) 2009	Vigor (1=highest, 9=poorest) 2010	Height (ft) 2009	Height (ft) 2010	Remarks (2009)
Rep 1							
70	1	x	3	3	1.25	2.00	
	2	x	4	3	1.25	1.75	
	3	x	NA	2	1.25	1.75	30% brown needles
105	1	x	3	1	1.25	2.25	
	2	x	3	1	1.50	2.00	good growth
	3	x	3	1	1.25	2.25	good growth
108	1	x	2	2	1.25	2.00	
	2	x	2	1	1.40	2.50	good growth
	3	x	4	3	1.00	1.25	stressed
PP	1	x	5	4	1.00	1.25	
	2	x	2	1	2.00	2.75	
	3	x	3	1	1.50	2.50	
107	1	x	2	1	1.75	2.75	good growth
	2	x	3	1	1.25	2.25	
	3	x	3	1	1.25	2.25	
MP-718	1	x	3	3	1.50	2.50	
	2	x	3	3	1.50	2.50	
	3	x	3	2	1.40	2.75	
109	1	x	3	3	1.50	2.00	
	2	x	3	2	1.50	2.50	
	3	x	4	2	1.50	2.00	exposed roots
1 (10)	1	x	4	2	1.25	2.00	
	2	x	2	1	1.75	3.00	
	3	x	4	3	1.25	2.00	
Rep 2							
70	1	x	3	1	1.50	2.50	
	2	x	2	1	1.75	2.75	
	3	x	3	3	1.50	2.25	
105	1	x	2	3	2.00	3.00	
	2	x	3	1	1.50	2.50	
	3	x	3	3	1.25	1.75	yellowish
108	1	x	4	4	1.25	1.75	bud gone
	2	x	4	3	1.50	2.00	
	3	x	4	3	1.25	3.00	
PP	1	x	4	2	1.50	2.50	
	2	x	4	2	1.50	2.25	
	3	x	3	2	1.50	2.25	

Accession No.	Plant No.	Survival	Vigor (1=highest, 9=poorest) 2009	Vigor (1=highest, 9=poorest) 2010	Height (ft) 2009	Height (ft) 2010	Remarks (2009)
107	1	x	3	1	2.00	3.00	
	2	x	3	2	1.50	2.25	
	3	x	2	2	1.25	2.00	
MP-718	1	x	3	3	1.25	3.00	
	2	x	3	3	1.50	2.25	
	3	x	4	4	1.25	1.25	
109	1	x	3	3	1.50	2.75	
	2	x	2	1	1.75	2.75	
	3	x	4	2	1.25	2.00	
1 (10)	1	x	3	3	2.00	2.25	
	2	x	4	2	1.50	2.25	
	3	x	3	2	1.50	2.25	
Rep 3							
70	1	x	4	2	1.25	1.75	dense Russian thistle
	2	x	3	1	1.50	2.25	dense Russian thistle
	3	x	4	2	1.25	2.25	dense Russian thistle
105	1	x	4	1	1.25	1.75	dense Russian thistle
	2	x	4	2	1.25	1.75	dense Russian thistle
	3	x	4	2	1.00	1.75	dense Russian thistle
108	1	x	4	2	1.00	2.50	dense Russian thistle
	2	x	3	1	1.75	2.25	dense Russian thistle
	3	x	4	4	1.25	1.75	dense Russian thistle
PP	1	x	4	3	1.25	1.75	dense Russian thistle
	2	x	4	2	1.50	2.25	dense Russian thistle
	3	x	5	3	1.00	1.25	dense Russian thistle
107	1	x	3	2	1.75	3.00	dense Russian thistle
	2	x	2	1	2.25	3.25	dense Russian thistle
	3	x	3	2	1.50	2.25	dense Russian thistle
MP-718	1	x	2	3	1.75	2.75	dense Russian thistle
	2	x	2	3	1.75	2.50	dense Russian thistle
	3	x	3	4	1.50	2.00	dense Russian thistle
MP 157	1	x	(Repl)	3	(Repl)	1.50	dense Russian thistle
109	2	x	4	2	1.00	1.25	dense Russian thistle
	3	x	4	1	1.25	1.75	dense Russian thistle
MP 158	1	x	(Repl)	2	(Repl)	1.50	dense Russian thistle
PP	2	x	(Repl)	3	(Repl)	0.75	dense Russian thistle
1 (10)	3	x	(Repl)	1	(Repl)	2.50	
Rep 4							
70	1	x	6	3	1.00	1.25	
	2	x	4	2	1.00	1.75	
	3	x	4	1	1.25	2.25	

Accession No.	Plant No.	Survival	Vigor (1=highest, 9=poorest) 2009	2010	Height (ft) 2009	2010	Remarks (2009)
105	1	x	3	1	1.50	2.25	
	2	x	2	1	2.00	3.25	
	3	x	3	1	1.50	2.25	
108	1	x	5	3	1.00	1.00	
	2	x	5	2	1.25	1.75	
	3	x	5	1	1.25	2.25	
PP	1	x	6	2	0.75	1.75	
	2	x	6	4	1.00	1.25	
	3	x	4	2	1.00	2.00	
MP-718	1	x	3	2	1.50	2.35	
	2	x	3	3	1.75	1.25	dense Russian thistle
	3	x	3	3	1.75	2.50	dense Russian thistle
107	1	x	4	1	1.50	2.50	dense Russian thistle
	2	x	6	2	1.25	1.25	dense Russian thistle
MP 157	3	x	(Repl)	2	(Repl)	1.50	dense Russian thistle
109	1	x	4	1	1.25	1.50	dense Russian thistle
	2	x	3	1	1.50	2.00	dense Russian thistle
	3	x	4	2	1.25	1.50	dense Russian thistle
1 (10)	1	x	3	1	1.75	2.25	dense Russian thistle
	2	x	4	1	1.50	2.25	dense Russian thistle
	3	x	5	2	1.25	1.75	dense Russian thistle
Rep 5							
70	1	x	6	2	1.25	1.50	brown needles
	2	x	6	1	1.25	1.50	no bud
	3	x	6	1	1.50	1.50	dense Russian thistle
MP 156	1	x	(Repl)	2	(Repl)	1.50	dense Russian thistle
MP 157	2	x	(Repl)	1	(Repl)	1.25	brown needles
105	3	x	5	4	1.50	1.00	dense Russian thistle
MP 157	1	x	(Repl)	2	(Repl)	1.25	dense Russian thistle
MP 154	2	x	(Repl)	1	(Repl)	1.50	dense Russian thistle
MP 157	3	x	(Repl)	1	(Repl)	1.25	dense Russian thistle
PP	1	x	4	1	1.50	1.50	dense Russian thistle
	2	x	4	1	1.25	1.50	dense Russian thistle
	3	x	4	4	1.25	1.50	dense Russian thistle
107	1	x	(Repl)	2	(Repl)	1.50	dense Russian thistle
	2	x	4	2	1.25	2.25	dense Russian thistle
	3	x	3	1	1.75	2.75	dense Russian thistle
MP-718	1	x	2	2	2.00	2.75	dense Russian thistle
	2	x	2	3	2.00	2.75	dense Russian thistle
	3	x	2	3	2.00	2.75	dense Russian thistle

Accession No.	Plant No.	Survival	Vigor (1=highest, 9=poorest) 2009	Vigor (1=highest, 9=poorest) 2010	Height (ft) 2009	Height (ft) 2010	Remarks (2009)
109	1	x	3	1	1.50	2.50	dense Russian thistle
	2	x	4	1	1.75	2.50	dense Russian thistle
	3	x	5	5	1.00	1.00	
1 (10)	1	x	4	1	1.50	2.75	
	2	x	3	1	1.25	2.25	
	3	x	2	1	1.75	2.25	

Table LP-7. Lodgepole pine evaluation (replicated) near Hettinger, North Dakota. 2011 and 2012 data

indicates replanted accession as of 2010

*** Accession column lists all replant sources from 2008 and 2009 as well as originals. No further replants unless planted by owners.*

Vigor rating (1-9): 1=best, 9=poorest

				5/27/2011			10/16/2012			
Site	Rep	Accession as of 2010**	Plant #	Vigor rating	Height (ft)	% brown top	Vigor rating	Height (ft)	Width (ft)	2012 Notes
Hettinger	1	070	1	3	2.25	15%	2	3.00	1.75	
Hettinger	1	MP-154	2	3	2.00	15%	2	2.75	1.75	
Hettinger	1	070	3	2	2.00	15%	4	3.75	2.00	yellow with brown tips
Hettinger	1	105	1	2	2.75	10%	2	4.25	3.00	
Hettinger	1	105	2	3	2.50	10%	2	3.25	2.50	
Hettinger	1	105	3	1	2.75	10%	2	4.25	2.75	
Hettinger	1	108	1	2	2.25	5%	2	3.50	2.25	
Hettinger	1	108	2	1	3.00	5%	2	5.00	3.75	
Hettinger	1	108	3	2	1.50	5%	2	2.75	1.25	
Hettinger	1	PP	1	3	1.25	10%	2	2.50	1.50	
Hettinger	1	PP	2	2	3.00	10%	2	5.75	4.50	
Hettinger	1	PP	3	2	2.75	10%	2	5.75	3.50	
Hettinger	1	107	1	1	3.25	< 5%	2	5.00	4.75	
Hettinger	1	107	2	1	2.75	< 5%	3	4.75	2.50	5% dead limbs
Hettinger	1	107	3	1	3.00	< 5%	1	4.75	3.50	
Hettinger	1	MP-718	1	1	3.00	< 5%	4	5.50	4.00	yellow needles
Hettinger	1	MP-718	2	1	3.00	< 5%	4	5.00	3.75	yellow needles
Hettinger	1	MP-718	3	1	3.25	< 5%	3	6.00	4.00	yellow needles
Hettinger	1	109	1	1	2.50	0%	2	4.25	3.50	
Hettinger	1	109	2	1	3.00	0%	2	5.00	4.00	
Hettinger	1	109	3	1	2.50	0%	2	4.75	3.00	
Hettinger	1	1-10	1	1	2.50	0%	2	5.50	3.00	
Hettinger	1	1-10	2	1	3.50	0%	2	5.50	4.50	
Hettinger	1	1-10	3	2	2.25	0%	2	4.75	3.25	
Hettinger	2	070	1	1	2.75	< 5%	2	4.75	2.75	
Hettinger	2	070	2	1	3.25	< 5%	2	6.00	3.75	
Hettinger	2	070	3	1	2.75	< 5%	2	4.75	2.50	

				5/27/2011			10/16/2012			
Site	Rep	Accession as of 2010**	Plant #	Vigor rating	Height (ft)	% brown top	Vigor rating	Height (ft)	Width (ft)	2012 Notes
Hettinger	2	105	1	2	3.50	0%	2	6.00	4.00	
Hettinger	2	105	2	1	3.00	0%	2	4.75	3.00	
Hettinger	2	105	3	3	3.00	0%	2	3.00	2.50	
Hettinger	2	108	1	5	2.00	10%	2	3.25	2.50	
Hettinger	2	108	2	3	2.25	10%	2	4.25	3.00	
Hettinger	2	108	3	3	2.25	10%	2	3.75	2.75	
Hettinger	2	PP	1	2	2.50	10%	2	5.00	3.75	
Hettinger	2	PP	2	2	2.50	10%	2	4.50	2.75	
Hettinger	2	PP	3	2	2.25	10%	2	4.75	4.50	
Hettinger	2	107	1	2	3.50	10%	2	5.00	3.50	
Hettinger	2	107	2	2	2.75	10%	2	4.25	3.00	
Hettinger	2	107	3	2	2.50	10%	2	4.00	2.75	
Hettinger	2	MP-718	1	4	2.75	20%	4	4.50	3.25	pale green with yellow tips
Hettinger	2	MP-718	2	3	2.50	20%	4	4.75	3.00	pale green with yellow tips
Hettinger	2	MP-718	3	4	2.00	20%	4	4.00	2.75	pale green with yellow tips
Hettinger	2	109	1	3	3.25	10%	5	4.75	4.00	30% laterals with live base and 6" dead tips
Hettinger	2	109	2	2	3.25	10%	3	5.00	4.50	10% laterals with live base and 6" dead tips
Hettinger	2	109	3	2	2.25	10%	3	4.25	3.00	5% laterals with live base and 6" dead tips
Hettinger	2	1-10	1	4	2.50	25%	4	4.00	3.25	20% laterals with live base and 6" dead tips
Hettinger	2	1-10	2	3	2.75	25%	3	4.25	2.25	5% laterals with live base and 6" dead tips
Hettinger	2	1-10	3	4	2.25	25%	3	4.00	3.25	
Hettinger	3	070	1	2	2.25	< 5%	2	3.75	2.75	
Hettinger	3	070	2	2	2.75	< 5%	2	5.25	3.25	grasshoppers ate 90% of needles on candle
Hettinger	3	070	3	2	2.50	< 5%	2	4.25	3.25	
Hettinger	3	105	1	2	2.00	< 5%	2	3.25	3.00	
Hettinger	3	105	2	2	2.00	< 5%	2	3.25	2.50	
Hettinger	3	105	3	2	2.00	< 5%	2	3.50	2.50	
Hettinger	3	108	1	3	3.00	< 5%	2	5.00	3.75	
Hettinger	3	108	2	1	2.75	< 5%	2	5.25	3.50	
Hettinger	3	108	3	3	1.75	< 5%	2	3.25	2.00	
Hettinger	3	PP	1	2	1.75	< 5%	2	4.25	3.00	

				5/27/2011			10/16/2012			
Site	Rep	Accession as of 2010**	Plant #	Vigor rating	Height (ft)	% brown top	Vigor rating	Height (ft)	Width (ft)	2012 Notes
Hettinger	3	PP	2	2	2.25	< 5%	2	5.25	2.75	
Hettinger	3	PP	3	3	1.25	< 5%	2	2.75	2.00	
Hettinger	3	107	1	3	3.50	< 5%	2	5.25	3.25	
Hettinger	3	107	2	2	3.75	< 5%	2	6.00	4.25	
Hettinger	3	107	3	3	2.75	< 5%	2	4.00	3.00	
Hettinger	3	MP-718	1	3	3.00	15%	3	4.75	3.00	yellow needles
Hettinger	3	MP-718	2	3	2.75	15%	3	5.00	3.00	yellow needles
Hettinger	3	MP-718	3	4	2.25	15%	3	4.00	3.00	yellow needles
Hettinger	3	MP-157	1	3	1.75	10%	5	3.50	2.25	pocket gopher under tree and yellow needles
Hettinger	3	109	2	4	1.75	10%	2	3.00	2.00	
Hettinger	3	109	3	4	2.25	10%	2	4.25	3.00	
Hettinger	3	MP-158	1	2	1.50	15%	3	3.25	2.25	
Hettinger	3	PP	2	3	1.00	15%	3	2.50	1.25	
Hettinger	3	1-10	3	3	3.00	15%	3	4.50	2.25	5% laterals with live base and 6" dead tips
Hettinger	4	070	1	4	1.50	20%	2	3.00	1.75	
Hettinger	4	070	2	3	2.00	20%	2	3.25	2.25	
Hettinger	4	070	3	2	2.75	20%	1	4.25	2.50	
Hettinger	4	105	1	2	2.75	10%	2	4.50	3.00	
Hettinger	4	105	2	2	3.75	10%	2	5.25	4.00	
Hettinger	4	105	3	2	2.25	10%	2	4.25	3.25	
Hettinger	4	108	1	5	1.00	20%	3	1.75	1.00	
Hettinger	4	108	2	3	2.25	20%	2	4.00	2.50	
Hettinger	4	108	3	3	2.75	20%	3	4.25	2.75	5% laterals with live base and 6" dead tips
Hettinger	4	PP	1	2	1.75	0%	3	3.75	2.75	smooth brome on edge of fabric
Hettinger	4	PP	2	5	1.25	0%	5	1.75	1.25	smooth brome on edge of fabric
Hettinger	4	PP	3	2	2.00	0%	3	4.00	3.00	smooth brome on edge of fabric
Hettinger	4	MP-718	1	2	2.50	20%	3	4.25	3.50	yellow needles
Hettinger	4	MP-718	2	4	1.50	20%	3	3.50	2.25	yellow needles
Hettinger	4	MP-718	3	3	3.00	20%	3	4.75	2.50	yellow needles
Hettinger	4	107	1	2	2.50	< 5%	4	3.50	1.50	limbs only on southeast side
Hettinger	4	107	2	3	1.25	< 5%	3	2.00	1.00	

				5/27/2011			10/16/2012			
Site	Rep	Accession as of 2010**	Plant #	Vigor rating	Height (ft)	% brown top	Vigor rating	Height (ft)	Width (ft)	2012 Notes
Hettinger	4	MP-157	3	3	1.75	< 5%	4	3.25	2.25	yellow needles
Hettinger	4	109	1	3	2.00	< 5%	3	2.75	1.75	
Hettinger	4	109	2	2	2.50	< 5%	2	3.75	3.00	bindweed
Hettinger	4	109	3	2	2.00	< 5%	3	3.00	2.25	bindweed
Hettinger	4	1-10	1	4	2.25	10%	3	3.50	1.75	bindweed
Hettinger	4	1-10	2	3	2.75	10%	4	4.00	2.25	bindweed
Hettinger	4	1-10	3	3	2.00	10%	4	4.00	1.75	bindweed
Hettinger	5	MP-154	1	2	1.75	0%	3	2.75	1.75	bindweed
Hettinger	5	MP-158	2	2	2.00	0%	3	3.75	2.75	bindweed
Hettinger	5	070	3	2	2.00	0%	2	3.50	1.25	bindweed
Hettinger	5	MP-156	1	3	1.75	10%	3	3.75	2.25	bindweed
Hettinger	5	MP-157	2	3	1.50	10%	4	2.25	1.50	bindweed
Hettinger	5	105	3	5	1.00	10%	7	1.00	0.50	bindweed
Hettinger	5	MP-157	1	2	1.50	0%	3	3.25	2.00	bindweed yellow needles
Hettinger	5	MP-154	2	2	1.75	0%	3	3.50	2.00	bindweed yellow needles
Hettinger	5	MP-157	3	3	1.50	0%	3	3.00	1.75	bindweed yellow needles
Hettinger	5	PP	1	3	1.50	0%	2	3.25	1.75	bindweed
Hettinger	5	PP	2	2	1.75	0%	2	3.25	2.50	bindweed
Hettinger	5	PP	3	4	1.50	0%	3	3.00	2.25	bindweed
Hettinger	5	UNKNOWN	1	3	1.75	10%	3	3.75	2.00	bindweed plus thistle
Hettinger	5	107	2	1	2.75	10%	2	4.25	2.50	bindweed
Hettinger	5	107	3	2	3.25	10%	3	4.75	2.75	bindweed 5% laterals with live base and 6" dead tips
Hettinger	5	MP-718	1	2	3.00	< 5%	2	5.00	3.75	bindweed yellow needles
Hettinger	5	MP-718	2	2	3.00	< 5%	3	4.75	4.00	bindweed yellow needles
Hettinger	5	MP-718	3	2	3.00	< 5%	3	5.00	4.00	bindweed yellow needles
Hettinger	5	109	1	3	3.00	10%	4	5.25	2.75	bindweed
Hettinger	5	109	2	3	3.00	10%	3	4.75	2.25	bindweed 15% laterals with live base and 6" dead tips
Hettinger	5	109	3	5	1.25	10%	4	1.75	1.00	bindweed
Hettinger	5	1-10	1	2	3.00	< 5%	2	4.75	2.75	
Hettinger	5	1-10	2	2	2.50	< 5%	2	4.75	3.25	
Hettinger	5	1-10	3	2	3.00	< 5%	2	5.25	3.25	

Table LP-8. Lodgepole pine evaluation planted in 2008 at Angustora State Park near Hot Springs, South Dakota. Data was collected on October 31, 2008.

Accession No.	Plant No.	Survival	Vigor (1 = highest, 9=poorest)	Height (ft)	Remarks
Rep 1					
70	1	dead	-	0.75	dead needles
70	2	x	6	1.00	
70	3	x	8	0.75	
105	1	dead	-		
105	2	x	7	1.00	
105	3	dead	-		
108	1	x	5	1.00	
108	2	dead	-		
108	3	x	4	1.00	
PP	1	x	4	1.25	
PP	2	x	3	1.25	
PP	3	x	3	1.25	
107	1	x	5	1.25	
107	2	x	5	1.25	needles at top only
107	3	x	5	1.25	needles at top only
MP-718	1	x	3	1.25	
MP-718	2	x	3	1.00	
MP-718	3	x	3	1.00	
109	1	x	4	1.50	
109	2	x	7	1.00	leader browsed
109	3	dead	-		
1 (10)	1	x	6	1.00	
1 (10)	2	x	7	0.75	
1 (10)	3	x	8	1.00	
Rep 2					
70	1	x	7	1.00	
70	2	x	8	1.00	
70	3	x	8	1.00	
105	1	dead	-		
105	2	dead	-		
105	3	dead	-		
108	1	x	5	0.75	
108	2	x	6	0.75	
108	3	x	6	1.00	
PP	1	x	2	1.50	
PP	2	x	3	1.00	
PP	3	x	3	1.00	
107	1	x	4	1.25	
107	2	x	5	1.50	needles on top only
107	3	x	6	1.25	
MP-718	1	x	4	1.25	
MP-718	2	x	4	1.25	
MP-718	3	x	5	1.00	

Accession No.	Plant No.	Survival	Vigor (1 = highest, 9=poorest)	Height (ft)	Remarks
109	1	x	6	1.00	
109	2	dead	-		
109	3	x	9	0.75	
1 (10)	1	x	6	0.75	
1 (10)	2	x	5	1.50	needles on top only
1 (10)	3	dead	-		
Rep 3					
70	1	x	9	0.50	
70	2	x	5	0.75	
70	3	x	6	1.00	
105	1	dead	-		
105	2	dead	-		
105	3	dead	-		
108	1	x	5	0.75	
108	2	x	3	0.75	
108	3	dead	-		
PP	1	x	3	1.25	
PP	2	x	4	1.00	
PP	3	x	3	1.00	
107	1	dead	-		
107	2	x	8	1.00	pulled out partially
107	3	dead	-		
MP-718	1	x	3	1.00	
MP-718	2	x	2	1.25	
MP-718	3	x	2	1.25	
109	1	x	4	1.00	
109	2	x	6	1.50	
109	3	dead	-		
1 (10)	1	x	4	1.25	
1 (10)	2	dead	-		
1 (10)	3	x	4	1.00	
Rep 4					
70	1	x	5	1.00	
70	2	dead	-		
70	3	x	5	1.00	
105	1	x	6	1.75	
105	2	x	6	0.75	
105	3	x	6	1.00	
108	1	x	9	0.50	
108	2	dead	-		
108	3	dead	-		
PP	1	x	2	1.25	
PP	2	x	3	1.00	
PP	3	x	3	1.00	
107	1	x	4	1.25	
107	2	x	6	1.00	

Accession No.	Plant No.	Survival	Vigor (1 = highest, 9=poorest)	Height (ft)	Remarks
107	3	x	5	1.25	
MP-718	1	x	4	1.25	
MP-718	2	x	4	1.75	leader browsed
MP-718	3	x	3	1.00	
109	1	x	6	1.25	
109	2	x	6	1.00	
109	3	dead	-		
1 (10)	1	x	7	1.00	
1 (10)	2	x	9	1.00	
1 (10)	3	dead	-		
Rep 5					
70	1	x	5	1.00	
70	2	x	6	1.00	
70	3	x	6	1.00	
105	1	x	3	0.75	
105	2	dead	-		
105	3	dead	-		
108	1	x	4	1.00	
108	2	x	3	0.75	
108	3	x	3	0.75	
PP	1	x	4	1.00	
PP	2	x	4	1.25	
PP	3	x	4	1.25	
107	1	x	7	1.25	
107	2	x	8	1.00	
107	3	dead	-		
MP-718	1	x	3	1.00	
MP-718	2	x	3	1.25	
MP-718	3	x	3	1.50	
109	1	x	6	0.75	
109	2	x	7	1.00	
109	3	dead	-		
1 (10)	1	x	7	1.00	
1 (10)	2	dead	-		
1 (10)	3	x	6	1.25	

Table LP-9. Lodgepole pine evaluation at Angustora State Park near Hot Springs, South Dakota. Data was collected on 10/13/09.

= dead plant at 2009 inventory

= dead plant at 2008 inventory and replanted spring 2009

= original accession died between 2008 inventory and spring 2009; replanted to listed accession in spring 2009.

Rep	Accession	Plant #	Vigor (1-9) 1 = best; 9=worst	Height (feet)	Remarks*
1	070	1	4	1.00	short with brown needles; protective cage
1	070	2	3	1.00	protective cage
1	070	3	4	1.25	very yellow but long needles; protective cage
1	105	1	4	1.00	protective cage
1	105	2	3	1.00	protective cage
1	105	3	2	1.00	protective cage
1	108	1	3	1.00	yellow but full; protective cage
1	108	2	4	0.75	short green needles; protective cage
1	108	3	9	0.00	protective cage
1	PP	1	3	1.25	protective cage
1	PP	2	4	1.00	laid over but alive; protective cage
1	PP	3	2	1.00	double leader; protective cage
1	107	1	9	0.00	protective cage
1	107	2	2	1.50	protective cage
1	107	3	9	0.00	protective cage
1	MP 158	1	3	1.50	protective cage
1	MP 718	2	4	0.50	only one branch not chewed; protective cage
1	MP 718	3	4	1.25	protective cage
1	109	1	9	0.00	protective cage
1	109	2	9	0.00	protective cage
1	109	3	2	1.75	protective cage
1	1-10	1	2	2.00	protective cage
1	1-10	2	2	1.50	protective cage
1	1-10	3	3	1.50	protective cage
2	070	1	3	1.00	protective cage
2	070	2	2	1.00	protective cage
2	070	3	9	0.00	protective cage
2	105	1	3	1.00	protective cage
2	105	2	9	0.00	protective cage
2	105	3	9	0.00	protective cage
2	108	1	3	1.25	protective cage
2	108	2	2	1.00	protective cage
2	108	3	3	1.00	protective cage
2	PP	1	3	1.00	protective cage
2	PP	2	3	1.25	protective cage
2	PP	3	3	1.00	protective cage

Rep	Accession	Plant #	Vigor (1-9) 1 = best; 9=worst	Height (feet)	Remarks
2	107	1	9	0.00	protective cage
2	107	2	9	0.00	protective cage
2	107	3	2	1.25	protective cage
2	MP 158	1	3	1.50	protective cage
2	MP 158	2	3	1.50	protective cage
2	MP 718	3	4	0.75	protective cage
2	109	1	3	2.00	protective cage
2	109	2	3	1.50	protective cage
2	109	3	3	1.25	protective cage
2	1-10	1	2	2.00	protective cage
2	1-10	2	2	1.25	protective cage
2	1-10	3	2	1.50	protective cage
3	070	1	3	1.00	protective cage
3	070	2	3	1.00	protective cage
3	070	3	3	0.75	protective cage
3	105	1	9	0.00	protective cage
3	105	2	9	0.00	protective cage
3	105	3	3	0.75	protective cage
3	108	1	3	1.00	protective cage
3	108	2	3	1.00	protective cage
3	108	3	4	0.50	protective cage
3	PP	1	4	1.00	protective cage
3	PP	2	5	1.00	protective cage
3	PP	3	4	1.00	protective cage
3	107	1	2	1.00	protective cage
3	107	2	2	1.00	protective cage
3	107	3	3	1.00	protective cage
3	MP 158	1	3	1.50	no protective cage
3	MP 718	2	4	1.50	no protective cage
3	MP 718	3	4	1.00	no protective cage
3	109	1	5	1.50	very yellow; no protective cage
3	109	2	3	1.50	no protective cage
3	109	3	3	1.75	no protective cage
3	1-10	1	4	1.50	all yellow; no protective cage
3	1-10	2	3	1.75	no protective cage
3	1-10	3	4	1.00	no protective cage
4	PP	1	2	1.00	no protective cage
4	PP	2	2	1.25	no protective cage
4	PP	3	3	1.25	no protective cage
4	PP	1	2	1.25	no protective cage
4	PP	2	2	1.25	no protective cage
4	PP	3	3	0.75	no protective cage
4	PP	1	2	1.00	no protective cage

Rep	Accession	Plant #	Vigor (1-9) 1 = best; 9=worst	Height (feet)	Remarks
4	PP	2	2	1.00	no protective cage
4	PP	3	3	1.25	no protective cage
4	PP	1	4	1.00	no protective cage
4	PP	2	4	1.00	2 plants in one hole or double leader; no cage
4	PP	3	3	1.00	no protective cage
4	PP	1	4	1.00	no protective cage
4	PP	2	3	1.00	no protective cage
4	PP	3	4	0.75	no protective cage
4	PP	1	2	1.00	no protective cage
4	PP	2	3	1.00	no protective cage
4	PP	3	3	0.75	no protective cage
4	PP	1	2	1.25	no protective cage
4	PP	2	6	0.25	only one live branch; no protective cage
4	PP	3	4	0.75	no protective cage
4	PP	1	2	1.00	no protective cage
4	PP	2	3	0.75	no protective cage
4	PP	3	2	0.75	no protective cage
5	PP	1	3	0.75	no protective cage
5	PP	2	3	1.00	no protective cage
5	PP	3	5	1.00	very bent; no protective cage
5	PP	1	3	1.00	no protective cage
5	PP	2	3	0.75	no protective cage
5	PP	3	5	1.00	no protective cage
5	PP	1	4	1.00	no protective cage
5	PP	2	4	1.00	no protective cage
5	PP	3	3	1.00	no protective cage
5	PP	1	5	1.00	no protective cage
5	PP	2	4	1.00	no protective cage
5	PP	3	4	1.25	no protective cage
5	PP	1	4	1.00	no protective cage
5	PP	2	4	1.00	no protective cage
5	PP	3	3	1.25	no protective cage
5	PP	1	2	1.00	no protective cage
5	MP 718	2	5	1.00	no protective cage
5	PP	3	3	1.00	no protective cage
5	PP	1	3	1.00	no protective cage
5	PP	2	3	1.00	no protective cage
5	PP	3	5	0.75	no protective cage
5	PP	1	3	0.75	no protective cage
5	PP	2	4	0.75	no protective cage
5	PP	3	4	1.00	no protective cage

*Most entries were replanted 5/6/09 due to deer damage. Protective cages were installed through most of replication 3 in 2009.

Table LP-10. Lodgepole pine evaluation at Angustora State Park near Hot Springs, South Dakota. Data was collected on 9/28/10. (Replications 4 and 5 were replanted to ponderosa pine and are not included in this table.)

Accession No.	Plant No.	Survival	Vigor (1=highest, 9=poorest) 2010	Height (ft) 2010	Remarks 2010
Rep 1					
70	1	x	4	1.25	yellow foliage
	2	x	4	1.50	
	3	x	4	1.25	
105	1	x	8	1.00	2 green needles
	2	x	4	1.00	
	3	x	1	1.50	
108	1	x	4	1.50	
	2	x	7	0.75	
	3	dead	NA	NA	
PP	1	x	3	1.75	
	2	x	7	0.50	
	3	x	2	1.75	
107	1	x	4	1.50	
	2	x	3	2.00	
	3	dead	NA	NA	
MP 158	1	x	3	2.00	
MP 718	2	x	6	1.00	
MP 718	3	x	3	1.75	volunteer elm
109	1	x	5	1.75	
	2	x	5	1.50	
	3	x	3	2.25	
1 (10)	1	x	4	2.50	yellow foliage
	2	x	2	2.25	
	3	x	2	2.00	
Rep 2					
70	1	x	3	1.25	
	2	x	3	1.50	
	3	x	4	1.50	no cage, flood sediments
105	1	x	4	1.25	no id stake
	2	dead	NA	NA	no id stake
	3	dead	NA	NA	no id stake
108	1	x	2	1.50	flood sediments
	2	x	8	1.00	1 live limb
	3	x	3	1.25	
PP	1	x	4	1.25	
	2	x	3	1.50	
	3	x	3	1.00	

Accession No.	Plant No.	Survival	Vigor (1=highest, 9=poorest) 2010	Height (ft) 2010	Remarks 2010
107	1	dead	NA	NA	
	2	dead	NA	NA	
	3	x	1	1.75	
MP 158	1	x	3	2.25	
MP 158	2	x	4	2.00	yellow foliage
	3	x	5	1.00	yellow/brown foliage
109	1	x	3	2.25	
	2	x	3	2.00	
	3	x	8	2.25	
1 (10)	1	x	4	2.25	
	2	x	3	2.00	
	3	x	5	2.25	
Rep 3					
70	1	x	2	1.00	
	2	x	5	0.75	
	3	x	6	0.50	
105	1	x	8	1.75	few green needles
	2	x	8	1.50	few green needles
	3	x	5	1.25	yellow
108	1	x	3	1.50	
	2	x	3	1.25	
	3	dead	NA	NA	
PP	1	x	7	1.00	
	2	dead	NA	NA	
	3	x	6	1.00	
107	1	x	4	1.75	
	2	dead	NA	NA	
	3	x	5	1.25	
MP 158	1	x	4	1.00	
MP 718	2	x	4	1.50	
MP 719	3	x	3	2.00	
109	1	x	5	1.50	
	2	x	5	1.25	
	3	x	NA	NA	
1 (10)	1	x	5	1.25	
	2	x	NA	NA	
	3	x	NA	NA	

Table LP-11. Lodgepole pine evaluation (replicated) at Angostura State Park near Hot Springs, South Dakota, 2011 and 2012 data.

original accession was replanted to listed accession in spring 2009.

*Accessions marked **MP** were replanted to unknown accession of Mongolian pine by field staff on 5/14/2010.*

do not use the figures for analysis of accessions, since plant has been replaced with another unknown accession

Vigor rating: 1-9; 1=best, 9=worst

				5/26/2011		10/17/2012		
Site	**Rep**	**Accession**	**Plant #**	**Vigor rating**	**Length (ft)**	**Vigor rating**	**Height (ft)**	**Width (ft)**
Angostura	1	070	1	4	1.50	9		
Angostura	1	070	2	5	1.50	9		
Angostura	1	070	3	3	1.50	9		
Angostura	1	105	1	9		9		
Angostura	1	105	2	5	1.00	9		
Angostura	1	105	3	2	2.00	4	2.25	2.25
Angostura	1	108	1	3	1.75	5	1.75	1.00
Angostura	1	108	2	4	2.00	9		
Angostura	1	**MP**	3	4	2.00	9		
Angostura	1	PP	1	2	2.00	3	2.25	1.00
Angostura	1	PP	2	8	0.50	9		
Angostura	1	PP	3	7	2.00	3	2.50	2.00
Angostura	1	**MP**	1	6	1.75	9		
Angostura	1	107	2	2	2.25	9		
Angostura	1	107	3	9		9		
Angostura	1	MP 158	1	4	2.25	9		
Angostura	1	MP 718	2	9		9		
Angostura	1	MP 718	3	4	2.00	9		
Angostura	1	**MP**	1	6	1.75	9		
Angostura	1	**MP**	2	6	1.50	9		
Angostura	1	109	3	2	3.00	3	2.75	1.75
Angostura	1	1-10	1	3	3.00	3	3.25	1.75
Angostura	1	**MP**	2	3	2.75	5	3.00	1.50
Angostura	1	**MP**	3	4	2.25	5	2.75	1.50
Angostura	2	070	1	2	1.50	2	1.75	1.50
Angostura	2	070	2	3	1.75	4	1.75	1.50
Angostura	2	**MP**	3	8	1.50	9		
Angostura	2	**MP**	1	4	1.50	9		
Angostura	2	**MP**	2	9		9		
Angostura	2	105	3	9		9		
Angostura	2	108	1	4	1.50	3	2.00	1.25
Angostura	2	108	2	7	1.00	5	1.00	0.50
Angostura	2	108	3	3	1.50	3	1.75	1.00
Angostura	2	PP	1	5	1.25	8	1.25	0.50
Angostura	2	PP	2	4	1.75	3	1.75	1.25
Angostura	2	PP	3	4	1.25	9		

				5/26/2011		10/17/2012		
Site	Rep	Accession	Plant #	Vigor rating	Length (ft)	Vigor rating	Height (ft)	Width (ft)
Angostura	2	**MP**	1	9		9		
Angostura	2	107	2	9		9		
Angostura	2	107	3	2	2.50	9		
Angostura	2	MP 158	1	3	2.50	9		
Angostura	2	MP 158	2	4	2.25	9		
Angostura	2	MP 718	3	5	1.25	9		
Angostura	2	109	1	3	3.00	4	3.25	2.00
Angostura	2	109	2	4	2.25	9		
Angostura	2	109	3	9		9		
Angostura	2	1-10	1	5	2.75	5	2.50	1.25
Angostura	2	1-10	2	4	2.25	4	2.50	2.00
Angostura	2	1-10	3	6	2.75	9		
Angostura	3	070	1	4	1.75	9		
Angostura	3	070	2	9		9		
Angostura	3	070	3	9		9		
Angostura	3	**MP**	1	9		9		
Angostura	3	**MP**	2	9		9		
Angostura	3	105	3	8	1.50	9		
Angostura	3	108	1	4	1.75	9		
Angostura	3	108	2	5	1.50	9		
Angostura	3	108	3	9		9		
Angostura	3	PP	1	8	1.25	9		
Angostura	3	**MP**	2	9		9		
Angostura	3	PP	3	8	1.00	9		
Angostura	3	107	1	7	2.00	9		
Angostura	3	**MP**	2	9		9		
Angostura	3	107	3	9		9		
Angostura	3	MP 158	1	9		9		
Angostura	3	MP 718	2	9		9		
Angostura	3	MP 718	3	9		9		
Angostura	3	**MP**	1	9		9		
Angostura	3	**MP**	2	9		9		
Angostura	3	MP	3	9		9		
Angostura	3	1-10	1	8	1.50	9		
Angostura	3	**MP**	2	9		9		
Angostura	3	1-10	3	9		9		
Angostura	4	PP	1	4	1.75	9		
Angostura	4	PP	2	4	1.75	3	2.00	1.50
Angostura	4	PP	3	4	1.50	3	1.75	1.50
Angostura	4	PP	1	4	2.00	3	1.75	1.50
Angostura	4	PP	2	5	1.75	6	1.75	1.00
Angostura	4	PP	3	4	1.25	4	1.75	1.00
Angostura	4	PP	1	9		9		

				5/26/2011		10/17/2012		
Site	Rep	Accession	Plant #	Vigor rating	Length (ft)	Vigor rating	Height (ft)	Width (ft)
Angostura	4	PP	2	5	1.50	5	1.50	1.00
Angostura	4	PP	3	5	1.00	9		
Angostura	4	PP	1	4	1.25	5	1.75	1.00
Angostura	4	PP	2	9		9		
Angostura	4	PP	3	3	1.75	4	2.00	1.50
Angostura	4	PP	1	9		9		
Angostura	4	PP	2	9		9		
Angostura	4	PP	3	5	1.50	6	1.00	0.50
Angostura	4	PP	1	9		9		
Angostura	4	PP	2	9		9		
Angostura	4	PP	3	4	1.25	9		
Angostura	4	PP	1	4	2.00	6	2.00	1.25
Angostura	4	PP	2	9		9		
Angostura	4	PP	3	9		9		
Angostura	4	PP	1	8	0.25	9		
Angostura	4	PP	2	9		9		
Angostura	4	PP	3	8	0.75	6	1.00	0.50
Angostura	5	PP	1	9		9		
Angostura	5	PP	2	9		9		
Angostura	5	PP	3	8	0.75	8	1.00	0.25
Angostura	5	PP	1	9		9		
Angostura	5	PP	2	9		9		
Angostura	5	PP	3	9		9		
Angostura	5	PP	1	9		9		
Angostura	5	PP	2	9		9		
Angostura	5	PP	3	9		9		
Angostura	5	PP	1	9		9		
Angostura	5	PP	2	9		9		
Angostura	5	PP	3	9		9		
Angostura	5	PP	1	9		9		
Angostura	5	PP	2	9		9		
Angostura	5	PP	3	9		9		
Angostura	5	PP	1	9		9		
Angostura	5	MP 718	2	9		9		
Angostura	5	PP	3	9		9		
Angostura	5	PP	1	9		9		
Angostura	5	PP	2	9		9		
Angostura	5	PP	3	9		9		
Angostura	5	PP	1	9		9		
Angostura	5	PP	2	9		9		
Angostura	5	PP	3	9		9		

Figure LP-1. 2012 Lodgepole pine survival summary by site and accession

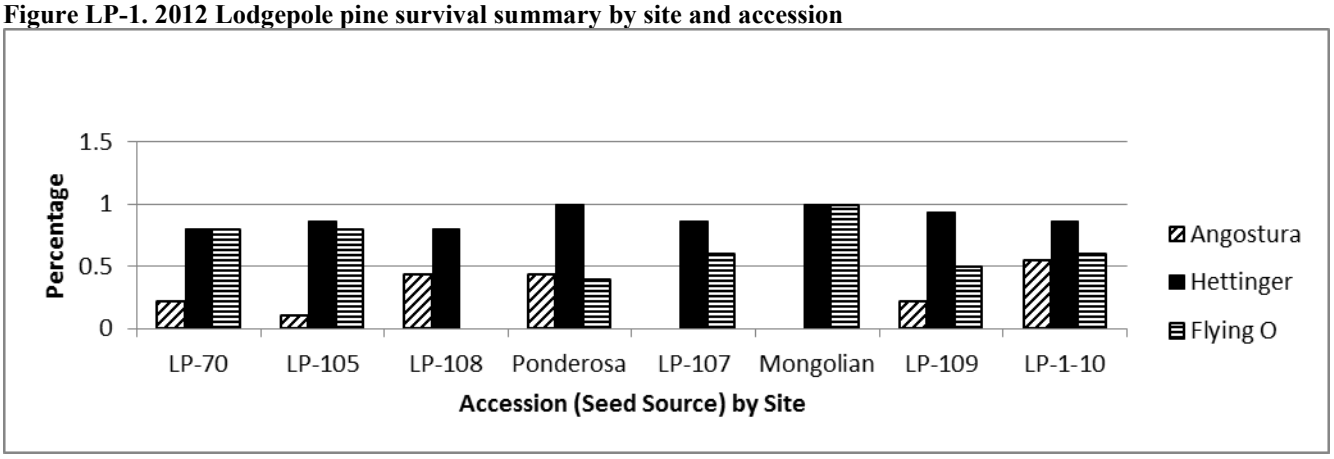


Figure LP-2. 2012 Lodgepole pine vigor summary by site and accession

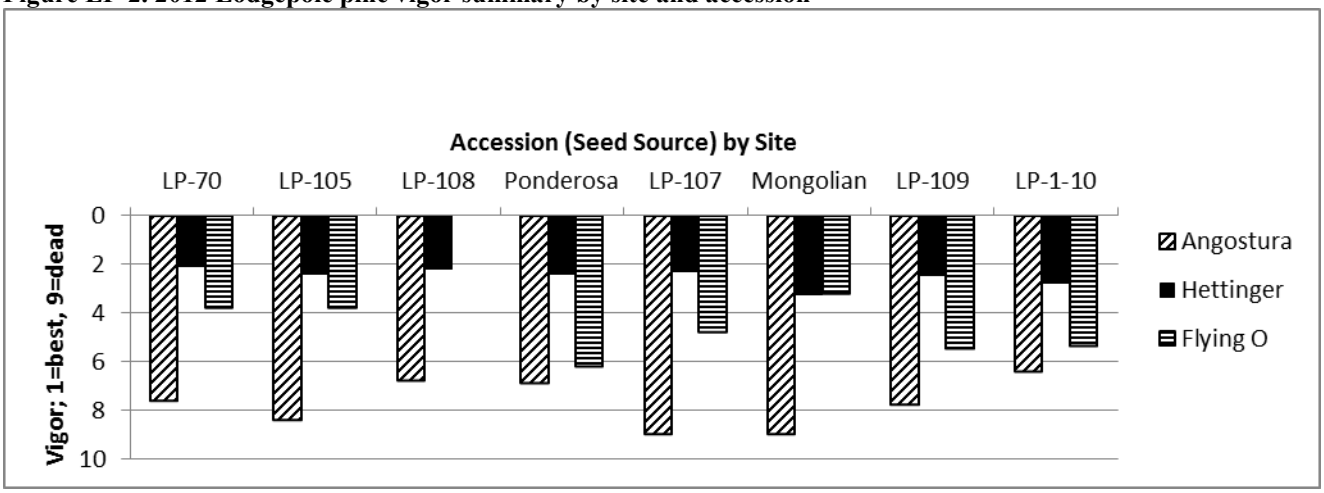


Figure LP-3. 2012 Lodgepole pine height summary by site and accession

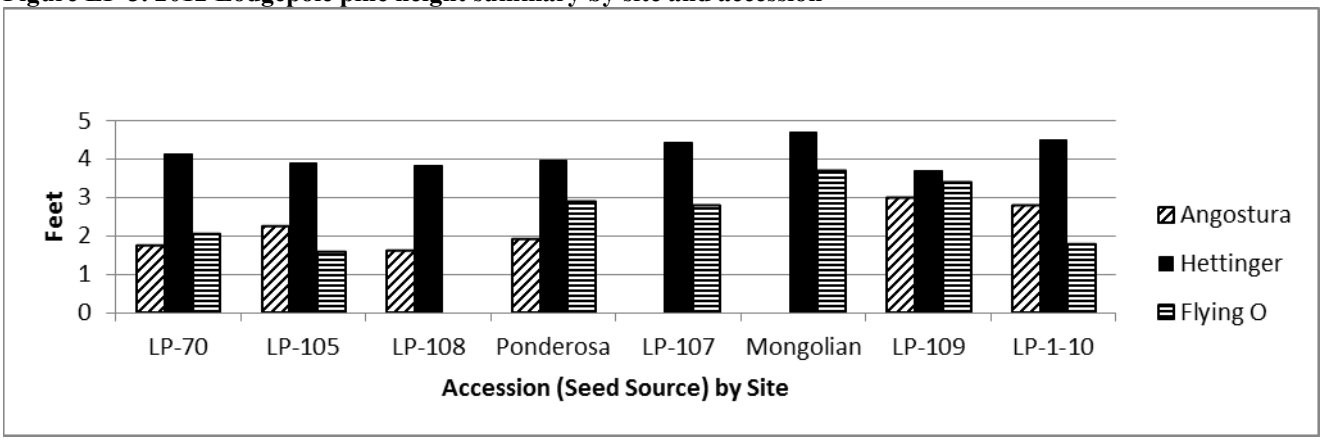
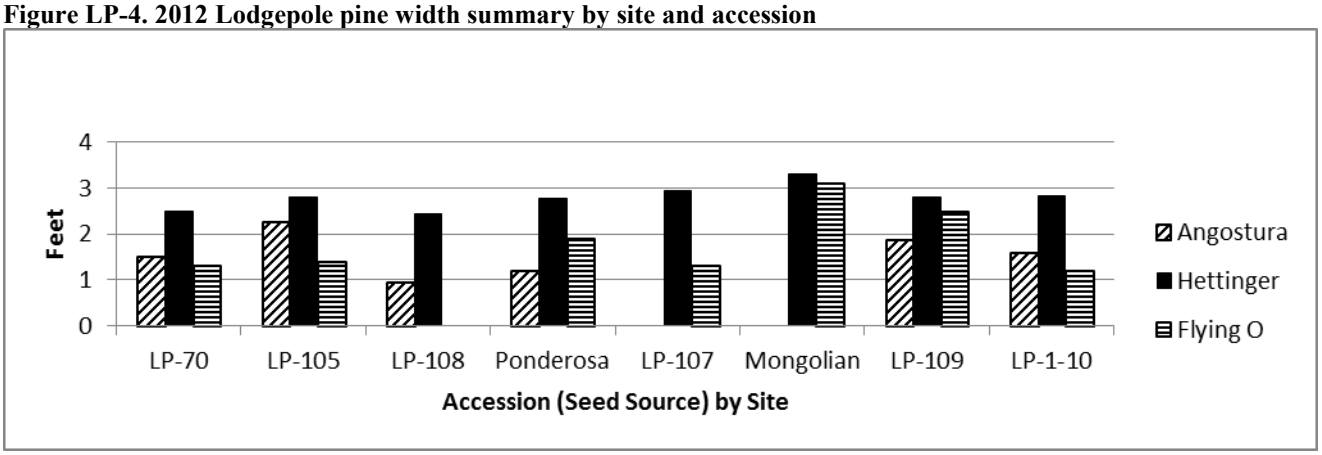


Figure LP-4. 2012 Lodgepole pine width summary by site and accession



MAJOR SEED SOURCE STUDIES AND ASSEMBLIES: TECHNICAL REPORT 2014

Study NDPMC-P-1102

Study Title: Evaluation of sandcherry *Prunus besseyi*

Summary: This study has been **TERMINATED** due to changing priorities, staffing levels, land availability, the normally short life of the species, and funding. The processed western sandcherry seed will be maintained in proper seed storage conditions at the Bismarck Plant Materials Center and will be available for future researchers. Seed quantities range from a dozen seeds to several grams, depending upon the seed source. Our thanks to those field office and other agency staff and individuals who helped with seed collection.

Objective: The purpose of this study was to evaluate and select improved sources of sand cherry with increased fruit yield and longevity. Such plants would have supported local agroforestry markets of fruits and preserves while still being beneficial as a windbreak species and for wildlife. Once completed the study area could have been converted to a seed orchard.

Introduction: Western sandcherry *Prunus besseyi* is native from the central Great Plains to the Prairie Provinces. It exhibits inconsistent fruit yields and size across conservation plantings. Not all plants produce fruit each year.

Western sandcherry *Prunus besseyi* is found on rocky, cobbly sites, usually in side slope positions. It does not compete with aggressive vegetation such as smooth brome, Kentucky bluegrass, crested wheatgrass or any of the suckering shrubs. Usually it is found on sites where some bare soil exists. It is often found in association with snowberry and poison ivy. Plants in the wild rarely have large fruit crops due in part to resident wildlife and rodents harvesting fruit before it is ripe. As with many *Prunus*, seed exhibits high incidences of seed weevil, sometimes exceeding 50% damaged seed.

Western sandcherry spreads slowly from basal sprouts. It does not sucker far from the plant. Some regeneration is from seed, especially in conservation plantings, if there is limited plant competition and appropriate bare soil. Eastern and northern seed sources might be *Prunus pumila* instead of *Prunus besseyi*.

Study Status: Seed from native sources and conservation plantings were to be planted in an initial evaluation nursery. Plants would have been selected for consistent high yields of large fruit. Fruit flavor could have been another selection criterion.

Seed was collected in 2011 from 38 sites; 19 in ND, 3 in MT, 11 in SD, 1 in MN, and 4 in NE. Most seed collection came from conservation plantings. Fourteen collections were from native stands.

From a Cornell web publication on sandcherry, "Superior clones selected were from the wild and used in a breeding program. As a result, the varieties Sioux, Brooks, and Black Beauty were released." A question one should ask is, since the report was from Cornell, were the species actually selected *besseyi* or *pumila*. *Pumila* is the eastern sandcherry.

Pawnee Buttes, registered as a ground cover version is the only improved commercial variety available in 2011. There is also reference to a Hansen's dwarf cherry, which is a selection of *besseyi* that is available through Lawyer Nursery in Montana. (Note: Pawnee Buttes and Hansens Dwarf Cherry are registered to: Botanic Gardens Conservation Int.) Twenty-four named releases have been identified (listed below). Most are from the early 20th century. Only the two discussed above remain available. None of these varieties are listed in the National Plant Germplasm System.

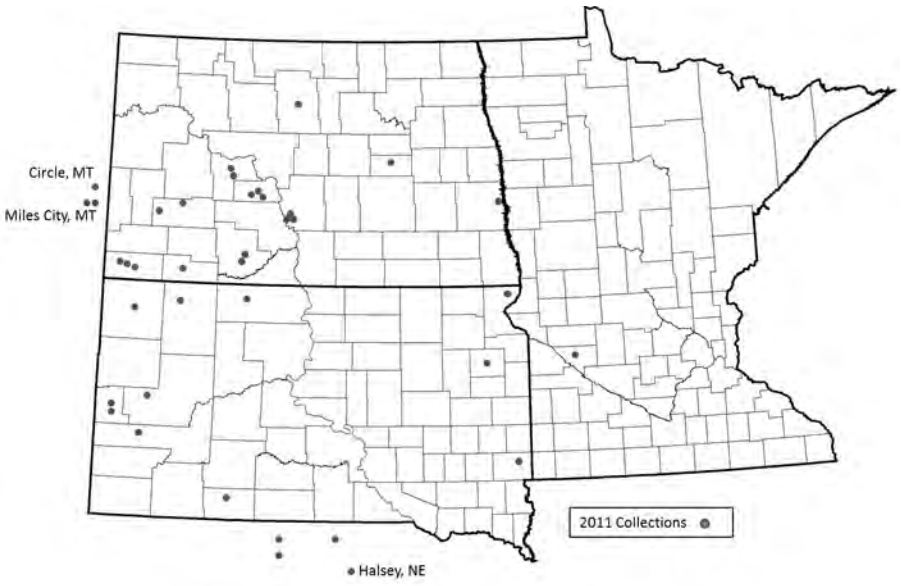
Variety	Remarks
Sioux	1913, Cornell
Brooks	Cornell
Black Beauty	Cornell
Hansens Dwarf Cherry®	
Oka	

Tom Thumb	
Compass	
Zumbra	
Sapa	seedling of *besseyi* pollinated with Sultan {Hansen}
Opata	
Nicollet	
St. Anthony	
Golden Boy	
Honeywood	
South Dakota Ruby	
Mando	
Monmoor	
Pawnee Buttes®	
Champa	1913, a seedling of Sioux
Heideman Black	1913
Heideman Red	1913
Heideman Yellow	1913
Rocky Mountain Cherry	1913
Tomahawk	1913

With the development of the sour cherries that continues today, there are many varieties of highly productive, edible fruit cherries on the market. Perhaps the need for a variety of sandcherry is quite small. Perhaps a more viable alternative would be to find commercial sour cherry varieties capable of withstanding conservation field conditions and include them as acceptable species for conservation plantings. Many of those varieties develop dense thickets. Depending upon varieties, heights could reach ten feet. They produce large quantities of fruit. There is no reason why a plant that provides conservation benefits such as snow and wind control, can't also provide large quantities of human food. Ideally they should be propagated from seed to reduce costs. Black chokeberry *Aronia melanocarpa* is currently fulfilling that role in plantings across the Dakotas and the Midwest as owners process the fruit for food, wines and pharmaceuticals.

The attached map identifies the general locations of sources of seed collected. The Bismarck PMC has specific site information for many of the collections.

Figure WS-1. Western sandcherry collection sites.



MAJOR SEED SOURCE STUDIES AND ASSEMBLIES: TECHNICAL REPORT – 2014

Study NDPMC-T-0008-WL

Study Title: Native Shrubs for Conservation, Skunkbush sumac *Rhus trilobata*

Summary: This current status of this planting is **INACTIVE** in an effort to reduce maintenance workload and focus on higher priority studies due to reorganization of the plant materials program which resulted in a shift of PMC priorities and direction.

Introduction: Skunkbush sumac is a native shrub which has been used to a limited extent in wildlife plantings, as well as other conservation plantings. It has potential for use in riparian plantings. In 1979 the variety 'Bighorn' was released by the New Mexico PMC. This accession originated from Basin, Wyoming, where the precipitation is 6.7 inches. There is some indication Bighorn skunkbush sumac is affected by rust when planted in areas of higher precipitation.

Objective: The PMC would like to find a selection from the Dakotas, east of the Badlands. This species has been reported to occur as far east as Emmons County, ND. There is a need for a selection which is adapted to more humid climates than the original Bighorn source. Seed sources from the most northern and most eastern ecotypes were collected.

Cooperators: USDA, NRCS Plant Materials Center and Lincoln-Oakes Nursery, Bismarck, ND.

Species Description: Skunkbush sumac is a deciduous, flowering native shrub. It grows 2 to 12 feet tall, but averages about 4 feet tall. It has a taproot and a fibrous root system. Roots are deep and extensively branched with somewhat shallow, spreading woody rhizomes. It sprouts readily from the root crown, especially after a severe disturbance. It is unlikely to reproduce vegetatively in the absence of disturbance. This sumac is reported to be dioecious. It is insect-pollinated. It reportedly has low seed production. It is estimated that only 5 to 15 percent of the flowers on the female plants actually produce seed. Acute drought may shorten twig growth and prevent fruit production. Sumac is tolerant of most soil textures, but prefers well-drained sites. It is intolerant of flooding and high-water tables.

Collection/Assembly: In September 1999, seed collections were made at 2 sites in the Cave Hills area of Harding County, SD. In September 2004, another collection was made, which was a composite of the two sites collected in 1999. In 2006, some collections were made in a number of locations, but possibly due to the drought, only small amounts were found. In South Dakota, seed was collected in Sully, Lyman, Todd, Ziebach, and Jones County. In North Dakota, seed was collected in Billings, Dunn, Slope, Golden Valley, and McKenzie County. One collection was also made in Powder River County, MT. In 2007, seed was collected in South Dakota from Corson and Sully Counties. North Dakota collections were from Dunn, McKenzie, Oliver, Slope, and Morton Counties.

Seedlings were grown of the Cave Hills collections. In the spring of 2001, only a few seedlings of 9082651 (north Cave Hills) were still alive. Survival of 9082653 (south Cave Hills) was much better. In 2003, seedlings of 9082653 were planted in the Off-Center Evaluation Plantings at Dickinson and Apple Valley. They are performing well.

Beginning on February 5, 2008, the seed lots collected in 2006 and 2007 were treated for 65 minutes with sulfuric acid. Following the acid treatment, the seed was cold stratified for 30 days, and then moved to the greenhouse. Table SS-1 lists the dates and numbers of plants emerged for each seed lot. Seed lots collected from the northern edge of the skunkbush sumac range in North Dakota had very poor germination. R.E. Farmer Jr. (1997) states that "pollination failure … may be a common occurrence on the northern edge of a species' range." In 2009, seedlings were maintained in the lathhouse. At the end of the growing season, most accessions were tall enough to be planted in 2010. The height varied from 9 inches to 21 inches.

Plot Preparation:
The site was clean tilled and plants were established in rows spaced 12 feet apart and a within row spacing of 8 feet.

Reference:
Farmer, R.E. Jr. 1997. Seed Ecophysiology of Temperate and Boreal Zone Forest Trees. DelRay, FL: St. Lucie Press. p.12

Planting:
Three-plant plots of 24 accessions of sumac were planted in three replications in May 2010 (see Figure SS-1). Most of these accessions were collected in 2006-2007. Several of the accessions planted in 2010 replaced original collections for which there were not sufficient plants. There were several other accessions that were short the minimum number of nine plants. Riverview Germplasm American black currant was used to fill to those few gaps in the planting.

Evaluations and Maintenance
2010: The sumac was evaluated in September. Notes were taken on survival, height, width and the presence of leaf spot. With above average rainfall and humidity this year, most of the plants had some leaf spot in 2010. In future evaluations, leaf diseases and fruit amount should be rated. Sumac does not usually produce a lot of fruit. If heavier producers could be found, selection could be made based on that characteristic.
2011:
May: Seeded 10 pounds blue grama between the rows of sumac to control erosion and reduce maintenance time requirements.
Late May: Mowed the new grass. Blue grama is coming well in most places. There are scattered dense patches of wild lettuce and Canadian thistle with an increasing presence of kochia.
June 5: Replanted 3 accessions that were part of the study and 3 dead border plants. Each was replanted to the original accession. There are no more replacements of Todd County seed source (9092063). Nine American black currant were replaced with 'Konza' aromatic sumac, a named release from the Manhattan Plant Materials Center. The plant positions replanted to Konza were determined by drawing from a hat. Each replant received about 2 gallons of water. Skies were overcast with a light breeze. Later that afternoon temps dropped to the low 70s and the site received ½ inch rain.
Summer: Maintenance for the remainder of the year was hoeing around each plant and mowing the blue grama. Plants have spread so much that only a push mower fits between plants. Old identification stakes were rotting off and replaced with embossed aluminum tags on fiberglass stakes.
July 15: Scored sumac with respect to disease presence.
August 12: Scored sumac with respect to disease presence. Since many of the leaves that were infected and yellowed had fallen off, half of previous score was added to presently observed score. Except for a few plants the incidence of disease did not increase much more than a single point (1=no disease present, 9=100% infected.)
November 1: Applied 1 teaspoon Casoron in a 2.5-ft diameter circle around each plant, including border rows to reduce weeds around each plant.
2012:
June 15: Applied 15 ml of Stinger in 3 gallons of water to 3000 square feet of plot. It took 5 batches of herbicide. Stinger was applied over top weeds and grasses and as a directed spray around the sumac avoiding sumac foliage as much as possible. Some sumac received a fair amount of Stinger as the plant was full of Canadian thistle.
July 5: Inventoried the entire planting. Generally, most plants showed 20-80% curled leaves, very similar to an herbicide injury. Several accessions showed fewer curled and small leaves. Generally, the north side of the plot had healthier looking plants. (Soils generally improve in plant productivity from southwest to northeast across the plot.) The Konza and several seed sources exhibited minimal herbicide damage symptoms. The blue grama grass exhibited a yellow cast. The yellow cast on the blue grama may have been the impact of drought on a young seeding or the impact of clopyrilid on the warm season grass. Potential herbicide interactions were discussed with the Dow Agro representative. Note: Lincoln-Oakes Nursery has applied Casoron to sumac for decades with no injury. Sumac is listed on the Transline (clopryilid) label. Perhaps there is an interaction between the two chemicals or perhaps the sumac tested by Dow Agro was not skunkbush. Responses from Dow representative indicated the sumac on Stinger label was probably 'Staghorn' as the studies were conducted in or around Virginia.
Fall: Clipped off Russian olive and other woody weeds, treating stumps with 50% solution of Cornerstone.
December 21: Applied .024 lb casoron (150 lb/ac) in 3-foot diameter circles to all plants.
2013:
General overall observations show that the Bighorn shows widespread breakage at branch angles just a few inches off the ground. The Konza, though smaller than the other seed sources exhibits a generally more vigorous and healthy green appearance with fewer deformed leaves. The grass has thickened considerably. A few Russian olive and Canada thistle are trying to become established, but considerably fewer than before the treatments in 2012. By the end of 2013 some of the plants appeared to be growing out of the herbicide stress. Leaf-out in spring of 2014 will tell much about the long term impacts of the herbicide.

Since conservation plant need priorities have changed and the demand for an eastern leaf spot resistant sumac is low, this study has been placed in inactive status. The planting will be maintained and available for future study, but data collection and analysis will not be performed. Seed sources exhibiting the poorest vigor and growth may be removed to simplify maintenance.

2014:

This planting will be removed in an effort to reduce maintenance workload and focus on higher priority studies due to reorganization of the plant materials program which resulted in a shift of PMC priorities and direction.

Table SS-1. Skunkbush sumac seed source study (seed stratification schedule, following sulphuric acid treatment)

lot #	accession	origin	insect holes in env.	medium	date start	date moved to green-house	date plants emerge	date of transplant	No.- April 1	Seed left (gr)	5/28/08 plants	Height Nov 08 (inches)
1	9092217	Corson Co., SD	x	potting soil	2/5/2008	3/11/2008	3/17/2008	3/31/2008	25	45.1	24	9
2	9092222	White Butte (Slope Co.)		potting soil	2/5/2008	3/11/2008	3/17/2008	3/31/2008	12	13.2	12	3.5
3	9092220	Sully Co., SD		potting soil	2/5/2008	3/11/2008	3/17/2008	3/31/2008	25	40	25	9
4	9092221	Arroda Lake (Oliver Co.)		potting soil	2/5/2008	3/11/2008					0	
5	BigHorn	Los Lunas PMC, NM		peat	2/5/2008	3/12/2008	3/18/2008	4/1/2008	13	25.6	13	10
6	9092218	Dunn Co., ND		peat	2/5/2008	3/12/2008	3/24/2008	4/1/2008	1		1	2.5
7	9092069	Powder River Co., MT	x	peat	2/5/2008	3/7/2008	3/12/2008	3/31/2008	25	11.6	25	2.5
8	9092128	Slope Co., ND	x	peat	2/6/2008	3/12/2008	3/20/2008	3/31/2008	5		5	4
9	9092068	McKenzie Co., ND		peat	2/6/2008	3/12/2008				3.4	1	2.5
10	9092067	Golden Valley Co., ND		peat	2/6/2008	3/12/2008	3/18/2008	4/1/2008	17	4	16	3
11	9092065	Jones Co., SD		peat	2/6/2008	3/14/2008	3/19/2008	4/1/2008	25	2	24	10
12	9092066	Billings Co., ND		peat	2/6/2008	3/14/2008	3/24/2008			7.5	8	5
13	9092064	Sully Co., SD		peat	2/6/2008	3/14/2008	3/20/2008	4/1/2008	25	10.4	20	5
14	9092058	Sully Co., SD		peat	2/6/2008	3/12/2008	3/18/2008	3/31/2008	25	16.7	25	7
15	9092059	Lyman Co., SD		peat	2/7/2008	3/18/2008	3/18/2008	4/1/2008	25	11.4	22	11
16	9092060	Todd Co., SD	x	peat	2/7/2008	3/20/2008	3/20/2008			4.8	14	9
17	9092130	Dunn Co., ND		peat	2/7/2008	3/19/2008	3/19/2008				9	2
18	9092063	Todd Co., SD	x	peat	2/7/2008	3/24/2008	3/24/2008	4/1/2008	25	15.3	25	8
19	9092062	Lyman Co., SD	x	peat	2/7/2008	3/11/2008	3/17/2008	3/31/2008	25	12.1	25	11
20	9092061	Ziebach Co., SD		peat	2/7/2008	3/14/2008	3/20/2008	4/1/2008	12		12	3
21	9092137	Dunn Co., ND		peat	2/7/2008	3/14/2008				3.6	0	
22	9092223	Morton Co., ND		peat	2/7/2008	3/14/2008	3/20/2008	4/1/2008	13		13	5
23	9092219	McKenzie Co., ND		peat	2/7/2008	3/14/2008	3/24/2008				10	8
24	9092129	Colorado		peat	2/7/2008	3/14/2008	3/20/2008	4/1/2008	1		1	19

Figure SS-1. Skunkbush sumac seed source study - plot layout

NORTH ↑

			B	B	B	B	B	B	B	B	B	B	B	B	B	B
	Rep 1	row 1	B	20	20	20	22	22	22	8	8	K	4	4	4	B
	Rep 1	row 2	B	17	17	K	14	14	14	3	3	3	9	9	9	B
	Rep 1	row 3	B	13	13	13	10	10	10	7	7	7	6	6	6	B
	Rep 1	row 4	B	24	24	24	23	23	23	19	19	19	18	18	18	B
	Rep 1	row 5	B	15	15	15	16	16	16	12	12	K	2	2	2	B
	Rep 1	row 6	B	11	11	11	5	5	5	21	21	21	1	1	1	B
	Rep 2	row 1	B	16	16	16	10	10	10	23	23	23	14	14	14	B
	Rep 2	row 2	B	21	21	21	13	13	13	4	4	4	12	12	K	B
	Rep 2	row 3	B	9	9	9	3	3	3	22	22	22	17	17	K	B
	Rep 2	row 4	B	18	18	18	6	6	6	7	7	7	24	24	24	B
	Rep 2	row 5	B	19	19	19	15	15	15	5	5	5	20	20	20	B
	Rep 2	row 6	B	1	1	1	2	2	2	11	11	11	8	X	K	B
	Rep 3	row 1	B	7	7	7	20	20	20	14	14	14	15	15	15	B
	Rep 3	row 2	B	10	10	10	19	19	19	23	23	K	6	6	6	B
	Rep 3	row 3	B	4	4	4	21	21	21	17	17	K	13	13	13	B
	Rep 3	row 4	B	2	2	2	11	11	11	8	8	K	18	18	18	B
	Rep 3	row 5	B	5	5	5	24	24	24	16	16	16	3	3	3	B
	Rep 3	row 6	B	9	9	9	22	22	22	12	12	X	1	1	1	B
			B	B	B	B	B	B	B	B	B	B	B	B	B	B

Rows start on west edge

1	9092217		Corson Co., SD
2	9092222		White Butte (Slope Co.)
3	9092220		Sully Co., SD
4	9094348		aromatic-Lincoln-Oakes Nursery
5	483445		Los Lunas PMC, NM (Bighorn)
6	9094338		Big Sioux Nursery
7	9092069		Powder River Co., MT
8	9092128		Slope Co., ND
9	9009467		Autumn Amber
10	9092067		Golden Valley Co., ND
11	9092065		Jones Co., SD
12	9092066		Billings Co., ND
13	9092064		Sully Co., SD
14	9092058		Sully Co., SD
15	9092059		Lyman Co., SD
16	9092060		Todd Co., SD
17	9092130		Dunn Co., ND
18	9092063		Todd Co., SD
19	9092062		Lyman Co., SD
20	9092061		Ziebach Co., SD
21	9094346		Cherry Co., NE
22	9092223		Morton Co., ND
23	9092219		McKenzie Co., ND
24	9094347		Morton Co., ND

X = American black currant replaces missing sumac plants (space holder)

B = border plants

K = 'Konza' sumac from Lincoln-Oakes Nursery planted to replace 9 healthy currant planted the year before to fill gaps in replication when enough sumac was not available. Which currant sites were replanted to Konza were determined randomly.

Note: Konza is a sumac variety released by the Manhattan Plant Materials Center. The release notice stated it was suited to eastern Kansas, SW Iowa, NW Missouri, and SE Nebraska. It has been sold by Lincoln-Oakes Nursery in Bismarck for several years. It was included in this study as a standard of comparison along with 'Bighorn' Skunkbush Sumac.

Table SS-2. Skunkbush sumac seed source study, performance data averaged 2010-2012

Accession	Avg. Disease all plants by acc. 2012*	Accession	Avg. Vigor all plants by acc. 2012*	Accession	Avg % curled leaves by Acc 2012*	Accession	Avg width all plants by acc. 2012 (ft)	Accession	Avg height all plants by acc. 2012 (ft)
Konza	1.5	9094346	3.3	9009467	20	9094348	5.6	9092219	3.9
9092220	2.2	9092065	3.4	9092065	24	9094338	5.5	9094348	3.8
9092064	2.2	Konza	3.4	9094348	26	9092217	5.4	9094346	3.6
9092067	2.3	9092220	3.5	9094338	27	9092067	5.3	9092059	3.5
9092065	2.4	9092063	3.6	9094347	30	9092220	5.2	9094338	3.5
9092062	2.4	9094348	3.6	9092058	32	9094347	5.1	Bighorn	3.5
9092059	2.5	9094338	3.7	9094346	34	9092066	5	9092066	3.5
9009467	2.6	9092058	3.8	Konza	35	9092058	4.8	9094347	3.4
9094348	2.6	9092217	3.9	9092217	38	9092059	4.8	9092220	3.4
9092058	2.6	9092064	4	9092061	43	9092219	4.8	9092058	3.3
9094346	2.6	9094347	4	9092130	45	9092060	4.8	9092067	3.3
9092217	2.6	9092059	4.1	9092069	47	9094346	4.7	9092065	3.2
9092128	2.6	9092061	4.3	9092220	47	9092064	4.7	9092217	3.2
9094338	2.7	9092062	4.3	Bighorn	47	Bighorn	4.7	9092128	3.1
9092063	2.8	9092128	4.4	9092222	50	9092223	4.7	9092064	3
9092223	2.8	9092130	4.5	9092064	54	9092065	4.5	9092062	2.8
9092130	2.9	9092223	4.6	9092128	54	9092063	4.4	9092063	2.8
9092069	2.9	Bighorn	4.7	9092063	55	9092222	4.3	9092069	2.6
9092222	2.9	9092067	4.8	9092062	56	9092128	4.3	9092130	2.6
9092219	2.9	9092069	4.8	9092059	58	9092062	4.2	Konza	2.6
9092060	2.9	9092219	5	9092067	59	9092130	4	9092060	2.6
9092066	2.9	9092060	5.1	9092223	59	9092061	3.8	9092222	2.4
9094347	3.2	9092222	5.1	9092219	69	9092069	3.8	9092223	2.4
9092061	3.4	9009467	5.3	9092060	72	Konza	3.3	9092061	2.3
Bighorn	4	9092066	5.7	9092066	88	9009467	3.2	9009467	1.1

*Scale is 1-9 (1= best vigor or no damage; 9= dead or about dead)

Note: Cupping and browning of leaf margins was noticed on most of the sumac and is reflected in Table SS-3.

Though differences between the top 50% of the seed sources were slight; Konza, a named release from the Manhattan Plant Materials Center and a source from Jones county, SD showed the best vigor, least disease, and least impact from a potential herbicide interaction. A seed source from Billings County, ND showed the most susceptibility to disease and herbicide injury and the lowest vigor of all seed sources. These plants have only grown for 3 years so further study is warranted before final conclusions are drawn. 2011 was extremely wet until mid-August. From that time through most of 2012 area precipitation was much below average..

Table SS-3. Skunkbush sumac seed source study performance data, 2010-2012

Accession	Rep	Row	Plants	Date	Vigor	Disease	Avg. Disease all plants by acc. 2012	Insect	Width	Height	% Curled brown leaves	Notes
9092061	1	1	1	2010 09 22	3	2			1.8	1.3		some leaf spot
9092061	1	1	1	2011 07 15		2						
9092061	1	1	1	2011 08 12		3						
9092061	1	1	1	2012 07 05	2	2		2			40	40% curled leaves
9092061	1	1	2	2010 09 22	3	2			2.6	1.6		some leaf spot
9092061	1	1	2	2011 07 15		3						
9092061	1	1	2	2011 08 12		5						
9092061	1	1	2	2012 07 05	3	2		2			60	60% curled leaves
9092061	1	1	3	2010 09 22	3	2			1.1	1.9		some leaf spot
9092061	1	1	3	2011 07 15		2						
9092061	1	1	3	2011 08 12		3						
9092061	1	1	3	2012 07 05	3	2		2			60	60% curled leaves
9092223	1	1	4	2010 09 27	4	2			1.8	1.1		
9092223	1	1	4	2011 07 15		2						disease more prevalent on interior and lower branches
9092223	1	1	4	2011 08 12		3						
9092223	1	1	4	2012 07 05	4	2		0	5.3	2.5	50	50% curled leaves possibly due to drought or herbicide
9092223	1	1	5	2010 09 27	4	2			2.2	1.8		
9092223	1	1	5	2011 07 15		2						disease more prevalent on interior and lower branches
9092223	1	1	5	2011 08 12		3						
9092223	1	1	5	2012 07 05	4	2		0	4.8	2.8	70	70% curled leaves possibly due to drought or herbicide
9092223	1	1	6	2010 09 27	4	2			2.4	1.4		
9092223	1	1	6	2011 07 15		2						disease more prevalent on interior and lower branches
9092223	1	1	6	2011 08 12		3						
9092223	1	1	6	2012 07 05	4	3		1	4.3	2	70	70% curled leaves possibly due to drought or herbicide
9092128	1	1	7	2010 09 27	3	6			1.8	1.6		
9092128	1	1	7	2012 07 05	3	2		1			50	50% curled leaves possibly due to drought or herbicide
9092128	1	1	7	2012 07 15		2						
9092128	1	1	7	2012 08 12		3	2.6					
9092128	1	1	8	2010 09 27	3	1			2.3	2.1		
9092128	1	1	8	2012 07 05	4	2		1			70	70% curled leaves possibly due to drought or herbicide
9092128	1	1	8	2012 07 15		2						

Accession	Rep	Row	Plants	Date	Vigor	Disease	Avg. Disease all plants by acc. 2012	Insect	Width	Height	% Curled brown leaves	Notes
9092128	1	1	8	2012 08 12		2						
	1	1	9	2010 09 27								this spot had been planted to currant
Konza	1	1	9	2012 07 05	6	2		1			20	20% curled leaves possibly due to drought or herbicide
Konza	1	1	9	2012 07 15		1						removed currant and replanted to Konza. Wanted to test Konza.
Konza	1	1	9	2012 08 12		1						
9094348	1	1	10	2010 09 27	2	1						
9094348	1	1	10	2011 07 15		1						
9094348	1	1	10	2011 08 12		1						
9094348	1	1	10	2012 07 05	1	1		1	8	4.5	10	10% curled leaves possibly due to drought or herbicide
9094348	1	1	11	2010 09 27	2	1						
9094348	1	1	11	2011 07 15		1						
9094348	1	1	11	2011 08 12		1						
9094348	1	1	11	2012 07 05	1	1		1	6	4.5	5	5% curled leaves possibly due to drought or herbicide
9094348	1	1	12	2010 09 27	3	2						
9094348	1	1	12	2011 07 15		2						
9094348	1	1	12	2011 08 12		1						
9094348	1	1	12	2012 07 05	2	1		1	6.5	3.8	10	10% curled leaves possibly due to drought or herbicide
9092130	1	2	1	2010 09 27	4	1			1.5	1.7		
9092130	1	2	1	2011 07 15		2						
9092130	1	2	1	2011 08 12		3						
9092130	1	2	1	2012 07 05	3	1		1	2.8	2.3	60	60% curled leaves possibly due to drought or herbicide
9092130	1	2	2	2010 09 27	4	1			1.8	2.1		
9092130	1	2	2	2011 07 15		1						
9092130	1	2	2	2011 08 12		2						
9092130	1	2	2	2012 07 05	3	1		1	4.3	3.3	20	20% curled leaves possibly due to drought or herbicide
	1	2	3	2010 09 27	9							this spot had been planted to currant
Konza	1	2	3	2011 07 15		1						removed currant and replanted to Konza. Wanted to test Konza.
Konza	1	2	3	2011 08 12		1						
Konza	1	2	3	2012 07 05	4	1		1	4.5	2.8	40	40% curled leaves possibly due to drought or herbicide
9092058	1	2	4	2010 09 27	4	2			1.6	1.9		
9092058	1	2	4	2011 07 15		2						

Accession	Rep	Row	Plants	Date	Vigor	Disease	Avg. Disease all plants by acc. 2012	Insect	Width	Height	% Curled brown leaves	Notes
9092058	1	2	4	2011 08 12		2						
9092058	1	2	4	2012 07 05	3	2		1	5.8	4.3	50	50% curled leaves possibly due to drought or herbicide
9092058	1	2	5	2010 09 27	5	2			1.5	1.3		
9092058	1	2	5	2011 07 15		2						
9092058	1	2	5	2011 08 12		3						
9092058	1	2	5	2012 07 05	3	3		1	5.3	2.7	20	20% curled leaves possibly due to drought or herbicide
9092058	1	2	6	2010 09 27	4	2			2.8	1.8		
9092058	1	2	6	2011 07 15		2						
9092058	1	2	6	2011 08 12		3						
9092058	1	2	6	2012 07 05	3	2		1	5.8	3	30	30% curled leaves possibly due to drought or herbicide
9092220	1	2	7	2010 09 27	4	2			1.8	1.7		
9092220	1	2	7	2011 07 15		2						
9092220	1	2	7	2011 08 12		3						
9092220	1	2	7	2012 07 05	3	2		1	6.8	4.8		
9092220	1	2	8	2010 09 27	3	2			2.3	2.3		
9092220	1	2	8	2011 07 15		2						
9092220	1	2	8	2011 08 12		2						
9092220	1	2	8	2012 07 05	4	3		1	4	2.8		
9092220	1	2	9	2010 09 27	4	3			8.3	8.3		
9092220	1	2	9	2011 07 15		2						
9092220	1	2	9	2011 08 12		3						
9092220	1	2	9	2012 07 05	2	2		1	5.8	3.3		
9009467	1	2	10	2010 09 27	3	2			2.8	1.3		
9009467	1	2	10	2011 07 15		2						
9009467	1	2	10	2011 08 12		2						old affected leaves had fallen. New leaves not infected.
9009467	1	2	10	2012 07 05	5	3		1			20	20% curled leaves possibly due to drought or herbicide
9009467	1	2	11	2010 09 27	3	2			4.4	0.7		
9009467	1	2	11	2011 07 15		2						
9009467	1	2	11	2011 08 12		2						old affected leaves had fallen. New leaves not infected.
9009467	1	2	11	2012 07 05	5	3		1			20	20% curled leaves possibly due to drought or herbicide
9009467	1	2	12	2010 09 27	3	2			3.6	0.8		

Accession	Rep	Row	Plants	Date	Vigor	Disease	Avg. Disease all plants by acc. 2012	Insect	Width	Height	% Curled brown leaves	Notes
9009467	1	2	12	2011 07 15		2						
9009467	1	2	12	2011 08 12		2						old affected leaves had fallen. New leaves not infected.
9009467	1	2	12	2012 07 05	5	2		1			60	60% curled leaves possibly due to drought or herbicide
9092064	1	3	1	2010 09 27	4	2			1.5	1.4		
9092064	1	3	1	2011 07 15		2						
9092064	1	3	1	2011 08 12		2						
9092064	1	3	1	2012 07 05	5	1		1	3.8	2.8	20	20% curled leaves possibly due to drought or herbicide
9092064	1	3	2	2010 09 27	4	2			2.5	1.8		
9092064	1	3	2	2011 07 15		1						
9092064	1	3	2	2011 08 12		1						
9092064	1	3	2	2012 07 05	4	1		1	5	3	40	40% curled leaves possibly due to drought or herbicide
9092064	1	3	3	2010 09 27	4	2			2.2	2.1		
9092064	1	3	3	2011 07 15		2						
9092064	1	3	3	2011 08 12		2						
9092064	1	3	3	2012 07 05	4	1		1	5	3	50	50% curled leaves possibly due to drought or herbicide
9092067	1	3	4	2010 09 27	4	2			1.6	1.5		
9092067	1	3	4	2011 07 15		2						
9092067	1	3	4	2011 08 12		3						
9092067	1	3	4	2012 07 05	5	2		1	5.3	3.3	60	60% curled leaves possibly due to drought or herbicide
9092067	1	3	5	2010 09 27	3	2			2	2.3		
9092067	1	3	5	2011 07 15		2						
9092067	1	3	5	2011 08 12		3						
9092067	1	3	5	2012 07 05	4	1		1	5.8	4	60	60% curled leaves possibly due to drought or herbicide
9092067	1	3	6	2010 09 27	4	2			1.6	1.7		
9092067	1	3	6	2011 07 15		2						
9092067	1	3	6	2011 08 12		3						
9092067	1	3	6	2012 07 05	4	2		1	5	3	60	60% curled leaves possibly due to drought or herbicide
9092069	1	3	7	2010 09 27	4	3			1.6	1.7		
9092069	1	3	7	2011 07 15		2						
9092069	1	3	7	2011 08 12		2						
9092069	1	3	7	2012 07 05	5	1		1	4.8	2.8	70	70% curled leaves possibly due to drought or herbicide

Accession	Rep	Row	Plants	Date	Vigor	Disease	Avg. Disease all plants by acc. 2012	Insect	Width	Height	% Curled brown leaves	Notes
9092069	1	3	8	2010 09 27	4	3			1.9	1.9		
9092069	1	3	8	2011 07 15		2						
9092069	1	3	8	2011 08 12		3						
9092069	1	3	8	2012 07 05	3	2		1	4.8	3.5	20	20% curled leaves possibly due to drought or herbicide
9092069	1	3	9	2010 09 27	5	3			1.5	1.3		
9092069	1	3	9	2011 07 15		2						
9092069	1	3	9	2011 08 12		3						
9092069	1	3	9	2012 07 05	7	4		2	3.3	2.5	0	0% curled leaves possibly due to drought or herbicide
9094338	1	3	10	2010 09 27	3	2			2.7	2.5		
9094338	1	3	10	2011 07 15		2						
9094338	1	3	10	2011 08 12		3						
9094338	1	3	10	2012 07 05	2	2		1	6.5	3.8	10	10% curled leaves possibly due to drought or herbicide
9094338	1	3	11	2010 09 27	3	2			1.6	2.1		
9094338	1	3	11	2011 07 15		3						
9094338	1	3	11	2011 08 12		4						
9094338	1	3	11	2012 07 05	4	2		1	4.5	3.3	30	30% curled leaves possibly due to drought or herbicide
9094338	1	3	12	2010 09 27	2	2			2.8	3.2		
9094338	1	3	12	2011 07 15		2						
9094338	1	3	12	2011 08 12		2						
9094338	1	3	12	2012 07 05	3	2		1	6.5	4.5	10	10% curled leaves possibly due to drought or herbicide
9094347	1	4	1	2010 09 27	3	2			2.5	2.7		
9094347	1	4	1	2011 07 15		3						
9094347	1	4	1	2011 08 12		4						
9094347	1	4	1	2012 07 05	5	2		1	4.5	3.3	20	20% curled leaves possibly due to drought or herbicide
9094347	1	4	2	2010 09 27	3	2			2.1	2.3		
9094347	1	4	2	2011 07 15		3						
9094347	1	4	2	2011 08 12		4						
9094347	1	4	2	2012 07 05	4	3		1	5.8	4.3	60	60% curled leaves possibly due to drought or herbicide
9094347	1	4	3	2010 09 27	3	2			1.5	1.9		
9094347	1	4	3	2011 07 15		2						
9094347	1	4	3	2011 08 12		3						

Accession	Rep	Row	Plants	Date	Vigor	Disease	Avg. Disease all plants by acc. 2012	Insect	Width	Height	% Curled brown leaves	Notes
9094347	1	4	3	2012 07 05	4	3		1	4.8	3.5	40	40% curled leaves possibly due to drought or herbicide
9092219	1	4	4	2010 09 27		2			2.7	2.3		
9092219	1	4	4	2011 07 15		2						very "fine", thin leaves
9092219	1	4	4	2011 08 12		3						
9092219	1	4	4	2012 07 05	7	2		1	3.5	2.8	100	100% curled leaves possibly due to drought or herbicide
9092219	1	4	5	2010 09 27		2			1.6	2		
9092219	1	4	5	2011 07 15		2						
9092219	1	4	5	2011 08 12		3						
9092219	1	4	5	2012 07 05	6	2		1	5.5	4.5	80	80% curled leaves possibly due to drought or herbicide
9092219	1	4	6	2010 09 27		2			1.6	2		
9092219	1	4	6	2011 07 15		3						sparse foliage
9092219	1	4	6	2011 08 12		5						
9092219	1	4	6	2012 07 05	5	2		1	4.8	4.5	60	60% curled leaves possibly due to drought or herbicide
9092062	1	4	7	2010 09 27	3	2			2.1	2.2		
9092062	1	4	7	2011 07 15		2						
9092062	1	4	7	2011 08 12		3						
9092062	1	4	7	2012 07 05	2	2		1	4.5	3.3	5	5% curled leaves possibly due to drought or herbicide
9092062	1	4	8	2010 09 27	3	2			2.2	2.3		
9092062	1	4	8	2011 07 15		2						
9092062	1	4	8	2011 08 12		3						
9092062	1	4	8	2012 07 05	2	2		1	6.3	3.3	5	5% curled leaves possibly due to drought or herbicide
9092062	1	4	9	2010 09 27	4	2			1	1.3		
9092062	1	4	9	2011 07 15		2						
9092062	1	4	9	2011 08 12		3						
9092062	1	4	9	2012 07 05	7	2		1	4.8	2.8	100	100% curled leaves possibly due to drought or herbicide
9092063	1	4	10	2010 09 27	3	2			2.3	2.1		
9092063	1	4	10	2011 07 15		3						
9092063	1	4	10	2011 08 12		4						
9092063	1	4	10	2012 07 05	3	2		1	5.3	3.5	5	5% curled leaves possibly due to drought or herbicide
9092063	1	4	11	2010 09 27	3	2			2.3	1.8		
9092063	1	4	11	2011 07 15		2						

Accession	Rep	Row	Plants	Date	Vigor	Disease	Avg. Disease all plants by acc. 2012	Insect	Width	Height	% Curled brown leaves	Notes
9092063	1	4	11	2011 08 12		4						
9092063	1	4	11	2012 07 05	3	2		1	5	3	5	5% curled leaves possibly due to drought or herbicide
9092063	1	4	12	2010 09 27	3	2			2.1	1.6		
9092063	1	4	12	2011 07 15		2						
9092063	1	4	12	2011 08 12		3						
9092063	1	4	12	2012 07 05	5	3		1	5	3	90	90% curled leaves possibly due to drought or herbicide
9092059	1	5	1	2010 09 27	3	4			2.2	2.4		
9092059	1	5	1	2011 07 15		2						
9092059	1	5	1	2011 08 12		3						
9092059	1	5	1	2012 07 05	5	3		1	4.5	3.3	60	60% curled leaves possibly due to drought or herbicide
9092059	1	5	2	2010 09 27	3	4			3.1	2.5		
9092059	1	5	2	2011 07 15		2						
9092059	1	5	2	2011 08 12		3						
9092059	1	5	2	2012 07 05	4	2		1	6.3	3.5	40	40% curled leaves possibly due to drought or herbicide
9092059	1	5	3	2010 09 27	3	4			1.2	2.7		
9092059	1	5	3	2011 07 15		3						
9092059	1	5	3	2011 08 12		4						
9092059	1	5	3	2012 07 05	3	2		1	5	4.3	40	40% curled leaves possibly due to drought or herbicide
9092060	1	5	4	2010 09 27	3	2			2.6	2.3		
9092060	1	5	4	2011 07 15		2						
9092060	1	5	4	2011 08 12		3						
9092060	1	5	4	2012 07 05	5	2		1	5.5	3	70	70% curled leaves possibly due to drought or herbicide
9092060	1	5	5	2010 09 27	4	2			1.8	1.8		
9092060	1	5	5	2011 07 15		2						
9092060	1	5	5	2011 08 12		4						
9092060	1	5	5	2012 07 05	7	3		1	4.8	2.8	80	80% curled leaves possibly due to drought or herbicide
9092060	1	5	6	2010 09 27	3	2			2.9	2.1		
9092060	1	5	6	2011 07 15		2						
9092060	1	5	6	2011 08 12		3						
9092060	1	5	6	2012 07 05	5	2		1	6.5	3.3	80	80% curled leaves possibly due to drought or herbicide
9092066	1	5	7	2010 09 27	3	4			2.3	2		

Accession	Rep	Row	Plants	Date	Vigor	Disease	Avg. Disease all plants by acc. 2012	Insect	Width	Height	% Curled brown leaves	Notes
9092066	1	5	7	2011 07 15		2						
9092066	1	5	7	2011 08 12		2						
9092066	1	5	7	2012 07 05	8	2		1	5.5	3.3	100	100% curled leaves possibly due to drought or herbicide
9092066	1	5	8	2010 09 27	3	4			2.4	2.6		
9092066	1	5	8	2011 07 15		2						
9092066	1	5	8	2011 08 12		2						
9092066	1	5	8	2012 07 05	7	2		1	6	4	95	95% curled leaves possibly due to drought or herbicide
	1	5	9	2010 09 27								this spot had been planted to currant
Konza	1	5	9	2011 07 15		1						removed currant and replanted to Konza. Wanted to test Konza.
Konza	1	5	9	2011 08 12		1						
Konza	1	5	9	2012 07 05	2	2		1	4.5	3.3	20	20% curled leaves possibly due to drought or herbicide
9092222	1	5	10	2010 09 27	4	2			2.8	1.8		
9092222	1	5	10	2011 07 15		2						
9092222	1	5	10	2011 08 12		3						
9092222	1	5	10	2012 07 05	4	2		1	4.8	3.5	60	60% curled leaves possibly due to drought or herbicide
9092222	1	5	11	2010 09 27	4	2			2.5	1.5		
9092222	1	5	11	2011 07 15		2						
9092222	1	5	11	2011 08 12		2						
9092222	1	5	11	2012 07 05	5	3		1	4.8	2.3	60	60% curled leaves possibly due to drought or herbicide
9092222	1	5	12	2010 09 27	4	2			3	1.6		
9092222	1	5	12	2011 07 15		2						
9092222	1	5	12	2011 08 12		3						
9092222	1	5	12	2012 07 05	4	3		1	5.5	2.8	50	50% curled leaves possibly due to drought or herbicide
9092065	1	6	1	2010 09 27	3	2			1.9	1.7		
9092065	1	6	1	2011 07 15		2						
9092065	1	6	1	2011 08 12		3						
9092065	1	6	1	2012 07 05	3	2		1	5.3	3.3	40	40% curled leaves possibly due to drought or herbicide
9092065	1	6	2	2010 09 27	3	2			1.8	2.4		
9092065	1	6	2	2011 07 15		2						
9092065	1	6	2	2011 08 12		4						
9092065	1	6	2	2012 07 05	3	2		1	3.8	3	10	10% curled leaves possibly due to drought or herbicide

Accession	Rep	Row	Plants	Date	Vigor	Disease	Avg. Disease all plants by acc. 2012	Insect	Width	Height	% Curled brown leaves	Notes
9092065	1	6	3	2010 09 27	3	2			1.8	2.1		
9092065	1	6	3	2011 07 15		2						
9092065	1	6	3	2011 08 12		3						
9092065	1	6	3	2012 07 05	2	2		1	3.3	3	50	5% curled leaves possibly due to drought or herbicide
Bighorn	1	6	4	2010 09 27	2	4			3	2.7		broken branches
Bighorn	1	6	4	2011 07 15		2						
Bighorn	1	6	4	2011 08 12		4						
Bighorn	1	6	4	2012 07 05	4	2		1	6.5	4	50	50% curled leaves possibly due to drought or herbicide
Bighorn	1	6	5	2010 09 27	2	4			2.4	2.9		
Bighorn	1	6	5	2011 07 15		2						
Bighorn	1	6	5	2011 08 12		3						
Bighorn	1	6	5	2012 07 05	6	3		1	4.3	3	60	60% curled leaves possibly due to drought or herbicide
Bighorn	1	6	6	2010 09 27	2	4			3	2.8		
Bighorn	1	6	6	2011 07 15		3						
Bighorn	1	6	6	2011 08 12		4						
Bighorn	1	6	6	2012 07 05	5	3		1	7	4.8	20	20% curled leaves possibly due to drought or herbicide
9094346	1	6	7	2010 09 27		2			2.7	1.8		
9094346	1	6	7	2011 07 15		3						
9094346	1	6	7	2011 08 12		3						
9094346	1	6	7	2012 07 05	4	2		1	7	5	50	50% curled leaves possibly due to drought or herbicide
9094346	1	6	8	2010 09 27		2			1.7	2		suckers
9094346	1	6	8	2011 07 15		2						
9094346	1	6	8	2011 08 12		2						
9094346	1	6	8	2012 07 05	3	2		1	5.3	3.8	50	50% curled leaves possibly due to drought or herbicide
9094346	1	6	9	2010 09 27		2			2.7	2		suckers
9094346	1	6	9	2011 07 15		2						
9094346	1	6	9	2011 08 12		4						
9094346	1	6	9	2012 07 05	4	2		1	5.5	4.3	70	70% curled leaves possibly due to drought or herbicide
9092217	1	6	10	2010 09 27	2	2			2.4	2.5		
9092217	1	6	10	2011 07 15		2						
9092217	1	6	10	2011 08 12		3						

Accession	Rep	Row	Plants	Date	Vigor	Disease	Avg. Disease all plants by acc. 2012	Insect	Width	Height	% Curled brown leaves	Notes
9092217	1	6	10	2012 07 05	3	2		1	4.8	4	30	30% curled leaves possibly due to drought or herbicide
9092217	1	6	11	2010 09 27	2	2			4	2.8		
9092217	1	6	11	2011 07 15		2						
9092217	1	6	11	2011 08 12		3						
9092217	1	6	11	2012 07 05	4	2		1	8	3.5	70	70% curled leaves possibly due to drought or herbicide
9092217	1	6	12	2010 09 27	2	2			3	2.2		
9092217	1	6	12	2011 07 15		2						
9092217	1	6	12	2011 08 12		3						
9092217	1	6	12	2012 07 05	3	2		1	5.5	3.5	70	70% curled leaves possibly due to drought or herbicide
9092060	2	1	1	2010 09 27	3	2			2.3	1.4		
9092060	2	1	1	2011 07 15		2						
9092060	2	1	1	2011 08 12		3						
9092060	2	1	1	2012 07 05	4	3		1	5	2.8	90	90% curled leaves possibly due to drought or herbicide
9092060	2	1	2	2010 09 27	3	2			3.1	2.3		
9092060	2	1	2	2011 07 15		2						
9092060	2	1	2	2011 08 12		3						
9092060	2	1	2	2012 07 05	4	3		1	5.5	3	90	90% curled leaves possibly due to drought or herbicide
9092060	2	1	3	2010 09 27	5	2			1.4	0.9		
9092060	2	1	3	2011 07 15		2						
9092060	2	1	3	2011 08 12		3						
9092060	2	1	3	2012 07 05	4	3		1	4.5	1.5	50	50% curled leaves possibly due to drought or herbicide
9092067	2	1	4	2010 09 27	3	2			2.5	2.1		
9092067	2	1	4	2011 07 15		2						
9092067	2	1	4	2011 08 12		3						
9092067	2	1	4	2012 07 05	5	2		1	6	3.8	80	80% curled leaves possibly due to drought or herbicide
9092067	2	1	5	2010 09 27	4	2			2.2	1.8		
9092067	2	1	5	2011 07 15		2						
9092067	2	1	5	2011 08 12		3						
9092067	2	1	5	2012 07 05	6	3		1	5	2.8	90	90% curled leaves possibly due to drought or herbicide
9092067	2	1	6	2010 09 27	4	2			1.8	2.2		
9092067	2	1	6	2011 07 15		2						

Accession	Rep	Row	Plants	Date	Vigor	Disease	Avg. Disease all plants by acc. 2012	Insect	Width	Height	% Curled brown leaves	Notes
9092067	2	1	6	2011 08 12		4						
9092067	2	1	6	2012 07 05	5	2		1	4.5	3.3	80	80% curled leaves possibly due to drought or herbicide
9092219	2	1	7	2010 09 27	2	4			3.8	2.5		
9092219	2	1	7	2011 07 15		3						
9092219	2	1	7	2011 08 12		4						
9092219	2	1	7	2012 07 05	4	2		1	6.5	4.3	70	70% curled leaves possibly due to drought or herbicide
9092219	2	1	8	2010 09 27	3	4			2	1.9		
9092219	2	1	8	2011 07 15		3						
9092219	2	1	8	2011 08 12		4						
9092219	2	1	8	2012 07 05	5	2		1	4	3.3	70	70% curled leaves possibly due to drought or herbicide
9092219	2	1	9	2010 09 27	2	4			2.3	3.2		
9092219	2	1	9	2011 07 15		2						
9092219	2	1	9	2011 08 12		4						
9092219	2	1	9	2012 07 05	4	3		1	5.5	4.3	80	80% curled leaves possibly due to drought or herbicide
9092058	2	1	10	2010 09 27	3	4			2	2		
9092058	2	1	10	2011 07 15		2						
9092058	2	1	10	2011 08 12		3						
9092058	2	1	10	2012 07 05	5	2		1	4.5	3	70	70% curled leaves possibly due to drought or herbicide
9092058	2	1	11	2010 09 27	3	4			2.9	2.6		
9092058	2	1	11	2011 07 15		2						
9092058	2	1	11	2011 08 12		3						
9092058	2	1	11	2012 07 05	3	2		1	5.5	4	20	20% curled leaves possibly due to drought or herbicide
9092058	2	1	12	2010 09 27	3	4			1.8	2.2		
9092058	2	1	12	2011 07 15		2						
9092058	2	1	12	2011 08 12		3						
9092058	2	1	12	2012 07 05	5	2		1	5	3.8	40	40% curled leaves possibly due to drought or herbicide
9094346	2	2	1	2010 09 27	3	2			2.3	2.3		
9094346	2	2	1	2011 07 15		2						
9094346	2	2	1	2011 08 12		3						
9094346	2	2	1	2012 07 05	2	1		1	4.3	3.5	0	0% curled leaves possibly due to drought or herbicide
9094346	2	2	2	2010 09 27	3	2			1.9	2.4		

Accession	Rep	Row	Plants	Date	Vigor	Disease	Avg. Disease all plants by acc. 2012	Insect	Width	Height	% Curled brown leaves	Notes
9094346	2	2	2	2011 07 15		2						
9094346	2	2	2	2011 08 12		3						
9094346	2	2	2	2012 07 05	3	4		1	4	3.5	0	0% curled leaves possibly due to drought or herbicide
9094346	2	2	3	2010 09 27	4	2			1.8	1.2		
9094346	2	2	3	2011 07 15		2						
9094346	2	2	3	2011 08 12		3						
9094346	2	2	3	2012 07 05	4	2		1	4.5	2.8	90	90% curled leaves possibly due to drought or herbicide
9092064	2	2	4	2010 09 27		2			2	1.7		
9092064	2	2	4	2011 07 15		2						
9092064	2	2	4	2011 08 12		3						
9092064	2	2	4	2012 07 05	4	3		1	4.5	3	80	80% curled leaves possibly due to drought or herbicide
9092064	2	2	5	2010 09 27		2			2.1	1.8		
9092064	2	2	5	2011 07 15		2						
9092064	2	2	5	2011 08 12		3						
9092064	2	2	5	2012 07 05	3	1		1	4	3.3	80	80% curled leaves possibly due to drought or herbicide
9092064	2	2	6	2010 09 27		2			2.2	1.7		
9092064	2	2	6	2011 07 15		2						
9092064	2	2	6	2011 08 12		3						
9092064	2	2	6	2012 07 05	4	3		1	6	3.3	60	60% curled leaves possibly due to drought or herbicide
9094348	2	2	7	2010 09 27	4	2			1.5	1.8		
9094348	2	2	7	2011 07 15		2						
9094348	2	2	7	2011 08 12		3						
9094348	2	2	7	2012 07 05	5	4		1	4.3	4	50	50% curled leaves possibly due to drought or herbicide
9094348	2	2	8	2010 09 27	3	2			2.3	2.7		
9094348	2	2	8	2011 07 15		2						
9094348	2	2	8	2011 08 12		3						
9094348	2	2	8	2012 07 05	5	4			6.3	4	80	80% curled leaves possibly due to drought or herbicide
9094348	2	2	9	2010 09 27	4	2			1.5	1.9		
9094348	2	2	9	2011 07 15		2						
9094348	2	2	9	2011 08 12		3						
9094348	2	2	9	2012 07 05	4	3		1	7	3.8	50	50% curled leaves possibly due to drought or herbicide

Accession	Rep	Row	Plants	Date	Vigor	Disease	Avg. Disease all plants by acc. 2012	Insect	Width	Height	% Curled brown leaves	Notes
9092066	2	2	10	2010 09 27	3	4			2.2	1.8		
9092066	2	2	10	2011 07 15		2						
9092066	2	2	10	2011 08 12		3						
9092066	2	2	10	2012 07 05	5	2		1	4.5	3.5	90	90% curled leaves possibly due to drought or herbicide
9092066	2	2	11	2010 09 27	3	4			2.1	2.5		
9092066	2	2	11	2011 07 15		3						
9092066	2	2	11	2011 08 12		3						
9092066	2	2	11	2012 07 05	4	3		1	5	4.3	80	80% curled leaves possibly due to drought or herbicide
	2	2	12	2010 09 27								this spot had been planted to currant
Konza	2	2	12	2011 07 15		2						removed currant and replanted to Konza. Wanted to test Konza.
Konza	2	2	12	2011 08 12		2						
Konza	2	2	12	2012 07 05	4	2		1	3.3	2.8	80	80% curled leaves possibly due to drought or herbicide
9009467	2	3	1	2010 09 27	4	2			1.8	0.8		
9009467	2	3	1	2011 07 15		2						
9009467	2	3	1	2011 08 12		2						
9009467	2	3	1	2012 07 05	7	5		1	3.5	0.8	20	20% curled leaves possibly due to drought or herbicide
	2	3	2	2010 09 27								plant # two not there according to notes
9009467	2	3	2	2011 07 15		2						replanted in spring 2011
9009467	2	3	2	2011 08 12		3						
9009467	2	3	2	2012 07 05	7	2		1	1.3	1.3	10	10% curled leaves possibly due to drought or herbicide
9009467	2	3	3	2010 09 27	4	2			1.9	1		
9009467	2	3	3	2011 07 15		2						
9009467	2	3	3	2011 08 12		2						
9009467	2	3	3	2012 07 05	5	4		1	3.3	0.8	20	20% curled leaves possibly due to drought or herbicide
9092220	2	3	4	2010 09 27	3	2			2.9	2.1		
9092220	2	3	4	2011 07 15		2						
9092220	2	3	4	2011 08 12		3						
9092220	2	3	4	2012 07 05	4	2		1	5.3	3.3	20	20% curled leaves possibly due to drought or herbicide
9092220	2	3	5	2010 09 27	3	2			2	2.1		
9092220	2	3	5	2011 07 15		2						
9092220	2	3	5	2011 08 12		3						

Accession	Rep	Row	Plants	Date	Vigor	Disease	Avg. Disease all plants by acc. 2012	Insect	Width	Height	% Curled brown leaves	Notes
9092220	2	3	5	2012 07 05	3	2		1	5.3	3.3	50	50% curled leaves possibly due to drought or herbicide
9092220	2	3	6	2010 09 27	3	2			2.7	2.2		
9092220	2	3	6	2011 07 15		1						
9092220	2	3	6	2011 08 12		1						
9092220	2	3	6	2012 07 05	4	2		1	5.3	3.3	60	60% curled leaves possibly due to drought or herbicide
9092223	2	3	7	2010 09 27	3	1			3.2	1.7		
9092223	2	3	7	2011 07 15		2						
9092223	2	3	7	2011 08 12		2						
9092223	2	3	7	2012 07 05	4	4		1	5.5	3.3	20	20% curled leaves possibly due to drought or herbicide
9092223	2	3	8	2010 09 27	3	1			3.3	1.7		
9092223	2	3	8	2011 07 15		2						
9092223	2	3	8	2011 08 12		2						
9092223	2	3	8	2012 07 05	4	4		1	5.8	2.8	80	80% curled leaves possibly due to drought or herbicide
9092223	2	3	9	2010 09 27	4	1			2	1.2		
9092223	2	3	9	2011 07 15		3						
9092223	2	3	9	2011 08 12		3						
9092223	2	3	9	2012 07 05	7	5		1	4.3	2.3	90	90% curled leaves possibly due to drought or herbicide
9092130	2	3	10	2010 09 27		6						
9092130	2	3	10	2011 07 15		5						black spots, not much yellow
9092130	2	3	10	2011 08 12		6						
9092130	2	3	10	2012 07 05	5	4		1	2.3	1.8	50	50% curled leaves possibly due to drought or herbicide
9092130	2	3	11	2010 09 27		5						
9092130	2	3	11	2011 07 15		2						
9092130	2	3	11	2011 08 12		4						
9092130	2	3	11	2012 07 05	4	2		1	7.3	2.8	90	90% curled leaves possibly due to drought or herbicide
	2	3	12	2010 09 27								this spot had been planted to currant
Konza	2	3	12	2011 07 15		1						removed currant and replanted to Konza. Wanted to test Konza.
Konza	2	3	12	2011 08 12		1						
Konza	2	3	12	2012 07 05	4	2		1	4	2.8	90	90% curled leaves possibly due to drought or herbicide
9092063	2	4	1	2010 09 27	4	2			1.5	1.2		
9092063	2	4	1	2011 07 15		1						

Accession	Rep	Row	Plants	Date	Vigor	Disease	Avg. Disease all plants by acc. 2012	Insect	Width	Height	% Curled brown leaves	Notes
9092063	2	4	1	2011 08 12		2						
9092063	2	4	1	2012 07 05	2	2		1	3.5	1.8	5	5% curled leaves possibly due to drought or herbicide
9092063	2	4	2	2010 09 27	4	2			1.3	1.8		
9092063	2	4	2	2011 07 15		2						
9092063	2	4	2	2011 08 12		3						
9092063	2	4	2	2012 07 05	4	2		1	3.8	2.8	100	100% curled leaves possibly due to drought or herbicide
9092063	2	4	3	2010 09 27	4	2			1.4	1.4		
9092063	2	4	3	2011 07 15		3						
9092063	2	4	3	2011 08 12		4						
9092063	2	4	3	2012 07 05	3	2		1	4.8	2.3	80	80% curled leaves possibly due to drought or herbicide
9094338	2	4	4	2010 09 27		2			1.8	1.4		
9094338	2	4	4	2011 07 15		2						
9094338	2	4	4	2011 08 12		3						
9094338	2	4	4	2012 07 05	5	4		1	3.8	2.3	20	20% curled leaves possibly due to drought or herbicide
9094338	2	4	5	2010 09 27		2			1.8	1.7		
9094338	2	4	5	2011 07 15		4						
9094338	2	4	5	2011 08 12		5						
9094338	2	4	5	2012 07 05	5	2		1	5.3	2.8	80	80% curled leaves possibly due to drought or herbicide
9094338	2	4	6	2010 09 27		2			2	2.2		
9094338	2	4	6	2011 07 15		4						
9094338	2	4	6	2011 08 12		5						
9094338	2	4	6	2012 07 05	3	3		1	5.3	3.8	20	20% curled leaves possibly due to drought or herbicide
9092069	2	4	7	2010 09 27	4	4			1.5	1.7		
9092069	2	4	7	2011 07 15		3						
9092069	2	4	7	2011 08 12		4						
9092069	2	4	7	2012 07 05	2	2		1	4.5	2.8	20	20% curled leaves possibly due to drought or herbicide
9092069	2	4	8	2010 09 27	4	4			2.5	1.7		
9092069	2	4	8	2011 07 15		2						
9092069	2	4	8	2011 08 12		3						
9092069	2	4	8	2012 07 05	6	2		1	6	3	90	90% curled leaves possibly due to drought or herbicide
9092069	2	4	9	2010 09 27	4	4			1.3	1.7		

Accession	Rep	Row	Plants	Date	Vigor	Disease	Avg. Disease all plants by acc. 2012	Insect	Width	Height	% Curled brown leaves	Notes
9092069	2	4	9	2011 07 15		2						
9092069	2	4	9	2011 08 12		3						
9092069	2	4	9	2012 07 05	5	2		1	3.5	3	90	90% curled leaves possibly due to drought or herbicide
9094347	2	4	10	2010 09 27	3	2			2.5	2.1		
9094347	2	4	10	2011 07 15		2						
9094347	2	4	10	2011 08 12		4						
9094347	2	4	10	2012 07 05	4	3		1	5.5	3.3	10	10% curled leaves possibly due to drought or herbicide
9094347	2	4	11	2010 09 27	2	2			2.3	2.8		
9094347	2	4	11	2011 07 15		2						
9094347	2	4	11	2011 08 12		5						
9094347	2	4	11	2012 07 05	3	3		1	5.8	3.8	20	20% curled leaves possibly due to drought or herbicide
9094347	2	4	12	2010 09 27	2	2			3	2.7		
9094347	2	4	12	2011 07 15		2						
9094347	2	4	12	2011 08 12		5						
9094347	2	4	12	2012 07 05	4	5		1	5.8	4.3	60	60% curled leaves possibly due to drought or herbicide
9092062	2	5	1	2010 09 27	4	2			1.8	1.4		
9092062	2	5	1	2011 07 15		2						
9092062	2	5	1	2011 08 12		3						
9092062	2	5	1	2012 07 05	5	3		1	3.5	2.3	90	90% curled leaves possibly due to drought or herbicide
9092062	2	5	2	2010 09 27	4	2			1.8	1.5		
9092062	2	5	2	2011 07 15		1						
9092062	2	5	2	2011 08 12		1						
9092062	2	5	2	2012 07 05	5	2		1	3.5	2.8	70	70% curled leaves possibly due to drought or herbicide
9092062	2	5	3	2010 09 27	4	2			1.3	1.3		
9092062	2	5	3	2011 07 15		3						
9092062	2	5	3	2011 08 12		4						
9092062	2	5	3	2012 07 05	6	2		1	2.8	2.3	100	100% curled leaves possibly due to drought or herbicide
9092059	2	5	4	2010 09 27	4	1			1.7	1.8		
9092059	2	5	4	2011 07 15		2						
9092059	2	5	4	2011 08 12		3						
9092059	2	5	4	2012 07 05	4	2		1	4.5	3	30	30% curled leaves possibly due to drought or herbicide

Accession	Rep	Row	Plants	Date	Vigor	Disease	Avg. Disease all plants by acc. 2012	Insect	Width	Height	% Curled brown leaves	Notes
9092059	2	5	5	2010 09 27	4	1			1.8	2		
9092059	2	5	5	2011 07 15		3						
9092059	2	5	5	2011 08 12		4						
9092059	2	5	5	2012 07 05	6	2		1	3.5	2.3	90	90% curled leaves possibly due to drought or herbicide
9092059	2	5	6	2010 09 27	3	1			2.8	2.3		
9092059	2	5	6	2011 07 15		1						
9092059	2	5	6	2011 08 12		2						
9092059	2	5	6	2012 07 05	4	3		1	4.8	4	80	80% curled leaves possibly due to drought or herbicide
Bighorn	2	5	7	2010 09 27	3	5			2.8	2		broken branches (split at forks)
Bighorn	2	5	7	2011 07 15		3						
Bighorn	2	5	7	2011 08 12		4						
Bighorn	2	5	7	2012 07 05	4	4		1			30	30% curled leaves possibly due to drought or herbicide
Bighorn	2	5	8	2010 09 27	2	5			2.8	2.8		
Bighorn	2	5	8	2011 07 15		2						
Bighorn	2	5	8	2011 08 12		4						
Bighorn	2	5	8	2012 07 05	4	6		1			50	50% curled leaves possibly due to drought or herbicide
Bighorn	2	5	9	2010 09 27	3	5			3.1	2.1		
Bighorn	2	5	9	2011 07 15		5						
Bighorn	2	5	9	2011 08 12		7						
Bighorn	2	5	9	2012 07 05	5	6		1			50	50% curled leaves possibly due to drought or herbicide
9092061	2	5	10	2010 09 27	3				1.4	2		
9092061	2	5	10	2011 07 15		2						
9092061	2	5	10	2011 08 12		3						
9092061	2	5	10	2012 07 05	5	4		1	4.5	3.3	30	30% curled leaves possibly due to drought or herbicide
9092061	2	5	11	2010 09 27	4				1.2	1.4		
9092061	2	5	11	2011 07 15		3						
9092061	2	5	11	2011 08 12		5						
9092061	2	5	11	2012 07 05	7	5		1	3	2.3	80	80% curled leaves possibly due to drought or herbicide
9092061	2	5	12	2010 09 27	4	6			2.2	1.4		
9092061	2	5	12	2011 07 15		2						
9092061	2	5	12	2011 08 12		5						

Accession	Rep	Row	Plants	Date	Vigor	Disease	Avg. Disease all plants by acc. 2012	Insect	Width	Height	% Curled brown leaves	Notes
9092061	2	5	12	2012 07 05	5	4		1	4.5	1.8	80	80% curled leaves possibly due to drought or herbicide
9092217	2	6	1	2010 09 27	3	2			1.8	1.3		
9092217	2	6	1	2011 07 15		3						
9092217	2	6	1	2011 08 12		5						
9092217	2	6	1	2012 07 05	5	2		1	4.3	2	5	5% curled leaves possibly due to drought or herbicide
9092217	2	6	2	2010 09 27	2	2			2.3	2.6		
9092217	2	6	2	2011 07 15		2						
9092217	2	6	2	2011 08 12		3						
9092217	2	6	2	2012 07 05	3	2		1	4	3.3	5	5% curled leaves possibly due to drought or herbicide
9092217	2	6	3	2010 09 27	4	2			1.4	1.3		
9092217	2	6	3	2011 07 15		2						
9092217	2	6	3	2011 08 12		3						
9092217	2	6	3	2012 07 05	5	4		1	3.8	2	20	20% curled leaves possibly due to drought or herbicide
9092222	2	6	4	2010 09 27	4	2			1.7	1.4		
9092222	2	6	4	2011 07 15		2						
9092222	2	6	4	2011 08 12		3						
9092222	2	6	4	2012 07 05	5	4		1	3	2	80	80% curled leaves possibly due to drought or herbicide
9092222	2	6	5	2010 09 27	4	2			2.7	1.8		
9092222	2	6	5	2011 07 15		2						
9092222	2	6	5	2011 08 12		5						
9092222	2	6	5	2012 07 05	6	5		1	4.3	2.8	60	60% curled leaves possibly due to drought or herbicide
9092222	2	6	6	2010 09 27	4	2			1.7	1.2		
9092222	2	6	6	2011 07 15		2						
9092222	2	6	6	2011 08 12		3						
9092222	2	6	6	2012 07 05	7	6		1	4.3	2	80	80% curled leaves possibly due to drought or herbicide
9092065	2	6	7	2010 09 27	3	2			2.9	2.3		
9092065	2	6	7	2011 07 15		2						
9092065	2	6	7	2011 08 12		4						
9092065	2	6	7	2012 07 05	4	2		1	5.8	3.3	0	0% curled leaves possibly due to drought or herbicide
9092065	2	6	8	2010 09 27	3	2			2.2	2.1		
9092065	2	6	8	2011 07 15		3						

Accession	Rep	Row	Plants	Date	Vigor	Disease	Avg. Disease all plants by acc. 2012	Insect	Width	Height	% Curled brown leaves	Notes
9092065	2	6	8	2011 08 12		5						
9092065	2	6	8	2012 07 05	4	3		1	4.5	3.3	0	0% curled leaves possibly due to drought or herbicide
9092065	2	6	9	2010 09 27	4	2			1.8	1.6		
9092065	2	6	9	2011 07 15		2						
9092065	2	6	9	2011 08 12		4						
9092065	2	6	9	2012 07 05	4	4		1	5.3	3.3	10	10% curled leaves possibly due to drought or herbicide
9092128	2	6	10	2010 09 27		2			1.5	1.3		
9092128	2	6	10	2011 07 15		2						
9092128	2	6	10	2011 08 12		4						
9092128	2	6	10	2012 07 05	5	3		1	4.5	3	50	50% curled leaves possibly due to drought or herbicide
	2	6	11	2010 09 27								this spot had been planted to currant
	2	6	11	2011 07 15								this spot remains currant
	2	6	11	2011 08 12								this spot remains currant
	2	6	11	2012 07 05								this spot remains currant
	2	6	12	2010 09 27								this spot previously planted to currant
Konza	2	6	12	2011 07 15		1						removed currant and replanted to Konza. Wanted to test Konza.
Konza	2	6	12	2011 08 12		1						
Konza	2	6	12	2012 07 05	4	2		1	2.8	2	50	50% curled leaves possibly due to drought or herbicide
9092069	3	1	1	2010 09 27	4	4			2	1.3		
9092069	3	1	1	2011 07 15		3						
9092069	3	1	1	2011 08 12		5						
9092069	3	1	1	2012 07 05	5	4		1	3	2	70	70% curled leaves possibly due to drought or herbicide
9092069	3	1	2	2010 09 27	4	4			1	1.3		
9092069	3	1	2	2011 07 15		2						
9092069	3	1	2	2011 08 12		4						
9092069	3	1	2	2012 07 05	5	3		1	2	2	30	30% curled leaves possibly due to drought or herbicide
9092069	3	1	3	2010 09 27	4	4			0.9	1.6		
9092069	3	1	3	2011 07 15		2						
9092069	3	1	3	2011 08 12		4						
9092069	3	1	3	2012 07 05	5	2	2.9	1	2.5	2.3	30	30% curled leaves possibly due to drought or herbicide
9092061	3	1	4	2010 09 27	4	4			1.4	1.1		

Accession	Rep	Row	Plants	Date	Vigor	Disease	Avg. Disease all plants by acc. 2012	Insect	Width	Height	% Curled brown leaves	Notes
9092061	3	1	4	2011 07 15		2						
9092061	3	1	4	2011 08 12		3						
9092061	3	1	4	2012 07 05	5	6		1	3	1.8	20	20% curled leaves possibly due to drought or herbicide
9092061	3	1	5	2010 09 27	4	4			1.9	1.6		
9092061	3	1	5	2011 07 15		2						
9092061	3	1	5	2011 08 12		4						
9092061	3	1	5	2012 07 05	4	4		1	4	2.3	10	10% curled leaves possibly due to drought or herbicide
9092061	3	1	6	2010 09 27	3	4			2.5	1.8		
9092061	3	1	6	2011 07 15		2						
9092061	3	1	6	2011 08 12		5						
9092061	3	1	6	2012 07 05	5	4	3.4	1	4	2.5	10	10% curled leaves possibly due to drought or herbicide
9092058	3	1	7	2010 09 27	4	2			2.3	1.5		
9092058	3	1	7	2011 07 15		2						
9092058	3	1	7	2011 08 12		3						
9092058	3	1	7	2012 07 05	5	3		1	4	2.3	40	40% curled leaves possibly due to drought or herbicide
9092058	3	1	8	2010 09 27	4	2			0.9	1.8		
9092058	3	1	8	2011 07 15		2						
9092058	3	1	8	2011 08 12		4						
9092058	3	1	8	2012 07 05	4	4		1	3	3.3	5	5% curled leaves possibly due to drought or herbicide
9092058	3	1	9	2010 09 27	4	2			1.5	1.9		
9092058	3	1	9	2011 07 15		3						
9092058	3	1	9	2011 08 12		5						
9092058	3	1	9	2012 07 05	4	3	2.6	1	4.5	3	10	10% curled leaves possibly due to drought or herbicide
9092059	3	1	10	2010 09 27	3	2			2.4	2.6		
9092059	3	1	10	2011 07 15		2						
9092059	3	1	10	2011 08 12		3						
9092059	3	1	10	2012 07 05	3	2		1	4.8	3.8	10	10% curled leaves possibly due to drought or herbicide
9092059	3	1	11	2010 09 27	3	2			1.8	2.3		
9092059	3	1	11	2011 07 15		2						
9092059	3	1	11	2011 08 12		3						
9092059	3	1	11	2012 07 05	4	3		1	5.3	4	80	80% curled leaves possibly due to drought or herbicide

Accession	Rep	Row	Plants	Date	Vigor	Disease	Avg. Disease all plants by acc. 2012	Insect	Width	Height	% Curled brown leaves	Notes
9092059	3	1	12	2010 09 27	3	2			1.8	2.6		
9092059	3	1	12	2011 07 15		2						
9092059	3	1	12	2011 08 12		4						
9092059	3	1	12	2012 07 05	4	2	2.5	1	5	3.8	90	90% curled leaves possibly due to drought or herbicide
9092067	3	2	1	2010 09 28	4	2			2.7	1.8		
9092067	3	2	1	2011 07 15		2						
9092067	3	2	1	2011 08 12		3						
9092067	3	2	1	2012 07 05	5	4		1			5	5% curled leaves possibly due to drought or herbicide
9092067	3	2	2	2010 09 28	4	2			2.3	1.8		
9092067	3	2	2	2011 07 15		2						
9092067	3	2	2	2011 08 12		4						
9092067	3	2	2	2012 07 05	4	2		1			50	50% curled leaves possibly due to drought or herbicide
9092067	3	2	3	2010 09 28	4	2			2.1	2		
9092067	3	2	3	2011 07 15		1						
9092067	3	2	3	2011 08 12		3						
9092067	3	2	3	2012 07 05	5	2	2.3	1			50	50% curled leaves possibly due to drought or herbicide
9092062	3	2	4	2010 09 28	4	2			1.8	1.8		
9092062	3	2	4	2011 07 15		2						
9092062	3	2	4	2011 08 12		4						
9092062	3	2	4	2012 07 05	5	3		1			80	80% curled leaves possibly due to drought or herbicide
9092062	3	2	5	2010 09 28	4	2			2.3	1.8		
9092062	3	2	5	2011 07 15		2						
9092062	3	2	5	2011 08 12		3						
9092062	3	2	5	2012 07 05	4	2		1			50	50% curled leaves possibly due to drought or herbicide
9092062	3	2	6	2010 09 28	2	2			2.8	2.4		
9092062	3	2	6	2011 07 15		2						
9092062	3	2	6	2011 08 12		3						
9092062	3	2	6	2012 07 05	3	5	2.4	1			0	0% curled leaves possibly due to drought or herbicide
9092219	3	2	7	2010 09 28	3	3			1.3	2.3		
9092219	3	2	7	2011 07 15		2						
9092219	3	2	7	2011 08 12		3						

Accession	Rep	Row	Plants	Date	Vigor	Disease	Avg. Disease all plants by acc. 2012	Insect	Width	Height	% Curled brown leaves	Notes
9092219	3	2	7	2012 07 05	4	2		1	4	4	5	5% curled leaves possibly due to drought or herbicide
9092219	3	2	8	2010 09 28	3	3			2.9	2.3		
9092219	3	2	8	2011 07 15		2						
9092219	3	2	8	2011 08 12		5						
9092219	3	2	8	2012 07 05	5	3	2.9	1	4.5	3.5	90	90% curled leaves possibly due to drought or herbicide
	3	2	9	2010 09 28								this spot had been planted to currant
Konza	3	2	9	2011 07 15		2						removed currant and replanted to Konza. Wanted to test Konza.
Konza	3	2	9	2011 08 12		2						
Konza	3	2	9	2012 07 05	3	2		1	2.3	2	10	10% curled leaves possibly due to drought or herbicide
9094338	3	2	10	2010 09 28	4	2			2	1.4		some dead branches on 1
9094338	3	2	10	2011 07 15		2						
9094338	3	2	10	2011 08 12		4						
9094338	3	2	10	2012 07 05	4	3		1	5.8	3.5	5	5% curled leaves possibly due to drought or herbicide
9094338	3	2	11	2010 09 28	4	2			1.2	1.8		
9094338	3	2	11	2011 07 15		2						
9094338	3	2	11	2011 08 12		3						
9094338	3	2	11	2012 07 05	4	2		1	5	4	20	20% curled leaves possibly due to drought or herbicide
9094338	3	2	12	2010 09 28	4	2			2	2.1		some dead branches on 3
9094338	3	2	12	2011 07 15		2						
9094338	3	2	12	2011 08 12		3						
9094338	3	2	12	2012 07 05	3	3	2.7	1	6.8	4	50	50% curled leaves possibly due to drought or herbicide
9094348	3	3	1	2010 09 28	3	4			1.8	2.1		
9094348	3	3	1	2011 07 15		2						
9094348	3	3	1	2011 08 12		3						
9094348	3	3	1	2012 07 05	5	5		1	3.8	3	5	5% curled leaves possibly due to drought or herbicide
9094348	3	3	2	2010 09 28	3	4			1.8	2.7		
9094348	3	3	2	2011 07 15		4						
9094348	3	3	2	2011 08 12		6						
9094348	3	3	2	2012 07 05	5	5		1	3.8	3.5	5	5% curled leaves possibly due to drought or herbicide
9094348	3	3	3	2010 09 28	4	4			0.8	1.8		
9094348	3	3	3	2011 07 15		2						

Accession	Rep	Row	Plants	Date	Vigor	Disease	Avg. Disease all plants by acc. 2012	Insect	Width	Height	% Curled brown leaves	Notes
9094348	3	3	3	2011 08 12		4						
9094348	3	3	3	2012 07 05	4	3	2.6	1	4.5	3.3	20	20% curled leaves possibly due to drought or herbicide
9094346	3	3	4	2010 09 28	4	2			2.3	1.8		
9094346	3	3	4	2011 07 15		3						
9094346	3	3	4	2011 08 12		6						
9094346	3	3	4	2012 07 05	3	3		1	3.8	3	20	20% curled leaves possibly due to drought or herbicide
9094346	3	3	5	2010 09 28	4	2			1.8	1.5		
9094346	3	3	5	2011 07 15		2						
9094346	3	3	5	2011 08 12		4						
9094346	3	3	5	2012 07 05	4	4		1	4.3	2.8	20	20% curled leaves possibly due to drought or herbicide
9094346	3	3	6	2010 09 28	4	2			1.5	2.1		
9094346	3	3	6	2011 07 15		2						
9094346	3	3	6	2011 08 12		5						
9094346	3	3	6	2012 07 05	3	2	2.6	1	4	3.5	5	5% curled leaves possibly due to drought or herbicide
9092130	3	3	7	2010 09 28	5	2			1.2	1.2		
9092130	3	3	7	2011 07 15		2						
9092130	3	3	7	2011 08 12		3						
9092130	3	3	7	2012 07 05	4	5		1	3.5	3	20	20% curled leaves possibly due to drought or herbicide
9092130	3	3	8	2010 09 28	4	2			1.4	1.8		
9092130	3	3	8	2011 07 15		2						
9092130	3	3	8	2011 08 12		4						
9092130	3	3	8	2012 07 05	5	4	2.9	1	4.3	2.8	30	30% curled leaves possibly due to drought or herbicide
	3	3	9	2010 09 28								this spot had been planted to currant
Konza	3	3	9	2011 07 15		1						removed currant and replanted to Konza. Wanted to test Konza.
Konza	3	3	9	2011 08 12		1						
Konza	3	3	9	2012 07 05	3	2		1	2.8	2.5	5	5% curled leaves possibly due to drought or herbicide
9092064	3	3	10	2010 09 28	3	2			2.7	2.4		
9092064	3	3	10	2011 07 15		2						
9092064	3	3	10	2011 08 12		3						
9092064	3	3	10	2012 07 05	3	3		1	5.5	3.3	20	20% curled leaves possibly due to drought or herbicide
9092064	3	3	11	2010 09 28	3	2			2.1	2.2		

Accession	Rep	Row	Plants	Date	Vigor	Disease	Avg. Disease all plants by acc. 2012	Insect	Width	Height	% Curled brown leaves	Notes
9092064	3	3	11	2011 07 15		2						
9092064	3	3	11	2011 08 12		2						
9092064	3	3	11	2012 07 05	4	6		1	4.8	3.3	50	50% curled leaves possibly due to drought or herbicide
9092064	3	3	12	2010 09 28	4	2			1.9	1.3		
9092064	3	3	12	2011 07 15		2						
9092064	3	3	12	2011 08 12		4						
9092064	3	3	12	2012 07 05	5	2	2.2	1	4	2	80	80% curled leaves possibly due to drought or herbicide
9092222	3	4	1	2010 09 28	4	2			2.1	1.6		
9092222	3	4	1	2011 07 15		2						
9092222	3	4	1	2011 08 12		3						
9092222	3	4	1	2012 07 05	5	3		1	4.3	2.3	0	0% curled leaves possibly due to drought or herbicide
9092222	3	4	2	2010 09 28	4	2			1.5	1.6		
9092222	3	4	2	2011 07 15		2						
9092222	3	4	2	2011 08 12		4						
9092222	3	4	2	2012 07 05	5	6		1	3.8	2	10	10% curled leaves possibly due to drought or herbicide
9092222	3	4	3	2010 09 28	5	2			1.2	1.1		
9092222	3	4	3	2011 07 15		2						
9092222	3	4	3	2011 08 12		5						
9092222	3	4	3	2012 07 05	5	6	2.9	1	3.8	2.3	50	50% curled leaves possibly due to drought or herbicide
9092065	3	4	4	2010 09 28	4	2			1.7	2		
9092065	3	4	4	2011 07 15		1						
9092065	3	4	4	2011 08 12		2						
9092065	3	4	4	2012 07 05	3	1		1	3.3	3	0	0% curled leaves possibly due to drought or herbicide
9092065	3	4	5	2010 09 28	4	2			1.5	1.8		
9092065	3	4	5	2011 07 15		2						
9092065	3	4	5	2011 08 12		4						
9092065	3	4	5	2012 07 05	4	2		1	4.3	3	50	50% curled leaves possibly due to drought or herbicide
9092065	3	4	6	2010 09 28	3	2			2.3	2.3		
9092065	3	4	6	2011 07 15		2						
9092065	3	4	6	2011 08 12		3						
9092065	3	4	6	2012 07 05	4	2	2.4	1	5	3.5	60	60% curled leaves possibly due to drought or herbicide

Accession	Rep	Row	Plants	Date	Vigor	Disease	Avg. Disease all plants by acc. 2012	Insect	Width	Height	% Curled brown leaves	Notes
9092128	3	4	7	2010 09 28	3	4			3.3	2.1		
9092128	3	4	7	2011 07 15		2						
9092128	3	4	7	2011 08 12		3						
9092128	3	4	7	2012 07 05	5	4		1	4	3	30	30% curled leaves possibly due to drought or herbicide
9092128	3	4	8	2010 09 28	4	4			1.7	1.8		
9092128	3	4	8	2011 07 15		2						
9092128	3	4	8	2011 08 12		4						
9092128	3	4	8	2012 07 05	5	4		1	4.3	3.3	70	70% curled leaves possibly due to drought or herbicide
	3	4	9	2010 09 28								this spot had been planted to currant
Konza	3	4	9	2011 07 15		2						
Konza	3	4	9	2011 08 12		3						
Konza	3	4	9	2012 07 05	1	1	1.5	1	2.8	2.8	0	0% curled leaves possibly due to drought or herbicide
9092063	3	4	10	2010 09 28	3	4			1.9	2		
9092063	3	4	10	2011 07 15		2						
9092063	3	4	10	2011 08 12		3						
9092063	3	4	10	2012 07 05	4	5		1	4.8	3	70	70% curled leaves possibly due to drought or herbicide
9092063	3	4	11	2010 09 28	4	4			1.1	1.3		
9092063	3	4	11	2011 07 15		2						
9092063	3	4	11	2011 08 12		3						
9092063	3	4	11	2012 07 05	4	5		1	4	2.8	70	70% curled leaves possibly due to drought or herbicide
9092063	3	4	12	2010 09 28	4	4			1.1	1.2		
9092063	3	4	12	2011 07 15		2						
9092063	3	4	12	2011 08 12		4						
9092063	3	4	12	2012 07 05	4	5	2.8	1	3.5	2.8	70	70% curled leaves possibly due to drought or herbicide
Bighorn	3	5	1	2010 09 28	1	4			3.7	3.4		
Bighorn	3	5	1	2011 07 15		2						
Bighorn	3	5	1	2011 08 12		6						
Bighorn	3	5	1	2012 07 05	5	5		1	3.8	2.5	80	80% curled leaves possibly due to drought or herbicide
Bighorn	3	5	2	2010 09 28	3	4			2.5	2.3		
Bighorn	3	5	2	2011 07 15		2						
Bighorn	3	5	2	2011 08 12		6						

Accession	Rep	Row	Plants	Date	Vigor	Disease	Avg. Disease all plants by acc. 2012	Insect	Width	Height	% Curled brown leaves	Notes
Bighorn	3	5	2	2012 07 05	5	5		1	4.3	3.5	60	60% curled leaves possibly due to drought or herbicide
Bighorn	3	5	3	2010 09 28	2	4			2.5	3.1		
Bighorn	3	5	3	2011 07 15		3						
Bighorn	3	5	3	2011 08 12		6						
Bighorn	3	5	3	2012 07 05	4	4	4	1	2.5	3.3	20	20% curled leaves possibly due to drought or herbicide
9094347	3	5	4	2010 09 28	3	2			1.9	2.1		
9094347	3	5	4	2011 07 15		2						
9094347	3	5	4	2011 08 12		4						
9094347	3	5	4	2012 07 05	4	3		1	3.3	2.5	20	20% curled leaves possibly due to drought or herbicide
9094347	3	5	5	2010 09 28	3	2			2.2	2		
9094347	3	5	5	2011 07 15		2						
9094347	3	5	5	2011 08 12		7						
9094347	3	5	5	2012 07 05	4	6		1	6	3	20	20% curled leaves possibly due to drought or herbicide
9094347	3	5	6	2010 09 28	4	2			2.3	1.9		broken branch
9094347	3	5	6	2011 07 15		2						
9094347	3	5	6	2011 08 12		6						
9094347	3	5	6	2012 07 05	4	6	3.2	1	4.3	3.3	20	20% curled leaves possibly due to drought or herbicide
9092060	3	5	7	2010 09 28	3	4			2.4	2		
9092060	3	5	7	2011 07 15		2						Check to see if this is Todd Co. 063 or Todd Co. 060
9092060	3	5	7	2011 08 12		5						
9092060	3	5	7	2012 07 05	4	4		1	1.3	0.8	5	5% curled leaves possibly due to drought or herbicide
9092060	3	5	8	2010 09 28	3	4			2.4	1.9		
9092060	3	5	8	2011 07 15		2						
9092060	3	5	8	2011 08 12		5						
9092060	3	5	8	2012 07 05	4	2		1	5.5	3.5	80	80% curled leaves possibly due to drought or herbicide
9092060	3	5	9	2010 09 28	4	4			2.2	1.5		
9092060	3	5	9	2011 07 15		2						
9092060	3	5	9	2011 08 12		8						
9092060	3	5	9	2012 07 05	9		2.9				100	Dead
9092220	3	5	10	2010 09 28	2	2			2.6	2.6		
9092220	3	5	10	2011 07 15		2						

Accession	Rep	Row	Plants	Date	Vigor	Disease	Avg. Disease all plants by acc. 2012	Insect	Width	Height	% Curled brown leaves	Notes
9092220	3	5	10	2011 08 12		2						
9092220	3	5	10	2012 07 05	3	2		1	4.8	4	50	50% curled leaves possibly due to drought or herbicide
9092220	3	5	11	2010 09 28	3	2			2	2.3		
9092220	3	5	11	2011 07 15		2						
9092220	3	5	11	2011 08 12		4						
9092220	3	5	11	2012 07 05	4	2		1	4.3	2.8	70	70% curled leaves possibly due to drought or herbicide
9092220	3	5	12	2010 09 28	3	2			1.4	2.2		
9092220	3	5	12	2011 07 15		1						
9092220	3	5	12	2011 08 12		3						
9092220	3	5	12	2012 07 05	3	3	2.2	1	4	3	30	30% curled leaves possibly due to drought or herbicide
9009467	3	6	1	2010 09 28	4	2			2.4	1.1		
9009467	3	6	1	2011 07 15		2						
9009467	3	6	1	2011 08 12		3						
9009467	3	6	1	2012 07 05	5	6		1	3.3	1.5	10	10% curled leaves possibly due to drought or herbicide
9009467	3	6	2	2010 09 28	4	2			2.6	1.5		
9009467	3	6	2	2011 07 15		2						
9009467	3	6	2	2011 08 12		3						
9009467	3	6	2	2012 07 05	5	6		1	3.5	1.5	10	10% curled leaves possibly due to drought or herbicide
9009467	3	6	3	2010 09 28	4	2			2.3	1.1		
9009467	3	6	3	2011 07 15		1						
9009467	3	6	3	2011 08 12		2						
9009467	3	6	3	2012 07 05	4	5	2.6	1	4.3	1	10	10% curled leaves possibly due to drought or herbicide
9092223	3	6	4	2010 09 28	4	4			2.3	1.4		
9092223	3	6	4	2011 07 15		2						
9092223	3	6	4	2011 08 12		3						
9092223	3	6	4	2012 07 05	5	4		1	3.5	1.5	40	40% curled leaves possibly due to drought or herbicide
9092223	3	6	5	2010 09 28	4	4			1.7	1.4		
9092223	3	6	5	2011 07 15		2						
9092223	3	6	5	2011 08 12		5						
9092223	3	6	5	2012 07 05	5	5		1	4.3	2.3	60	60% curled leaves possibly due to drought or herbicide
9092223	3	6	6	2010 09 28	3	4			3	2.2		

Accession	Rep	Row	Plants	Date	Vigor	Disease	Avg. Disease all plants by acc. 2012	Insect	Width	Height	% Curled brown leaves	Notes
9092223	3	6	6	2011 07 15		2						
9092223	3	6	6	2011 08 12		4						
9092223	3	6	6	2012 07 05	4	3	2.8	1	4.8	2.5	50	50% curled leaves possibly due to drought or herbicide
9092066	3	6	7	2010 09 28	3	2			3.4	2.3		
9092066	3	6	7	2011 07 15		2						
9092066	3	6	7	2011 08 12		4						
9092066	3	6	7	2012 07 05	5	4		1	6	4	80	80% curled leaves possibly due to drought or herbicide
9092066	3	6	8	2010 09 28	5	2			1.1	0.8		
9092066	3	6	8	2011 07 15		2						
9092066	3	6	8	2011 08 12		4						
9092066	3	6	8	2012 07 05	5	5	2.9	1	3.5	2.3	80	80% curled leaves possibly due to drought or herbicide
	3	6	9	2010 09 28								this spot had been planted to currant
	3	6	9	2011 07 15								this spot remains currant
	3	6	9	2011 08 12								this spot remains currant
	3	6	9	2012 07 05								this spot remains currant
9092217	3	6	10	2010 09 28	2	2			3.3	2.6		
9092217	3	6	10	2011 07 15		2						
9092217	3	6	10	2011 08 12		5						
9092217	3	6	10	2012 07 05	4	4		1	6.5	3.3	80	80% curled leaves possibly due to drought or herbicide
9092217	3	6	11	2010 09 28	3	2			3	1.9		
9092217	3	6	11	2011 07 15		2						
9092217	3	6	11	2011 08 12		4						
9092217	3	6	11	2012 07 05	4	3		1	5	3.3	5	5% curled leaves possibly due to drought or herbicide
9092217	3	6	12	2010 09 28	2	2			2.8	2.8		
9092217	3	6	12	2011 07 15		2						
9092217	3	6	12	2011 08 12		4						
9092217	3	6	12	2012 07 05	4	3	2.6	1	7	3.8	60	60% curled leaves possibly due to drought or herbicide

MAJOR SEED SOURCE STUDIES AND ASSEMBLIES: TECHNICAL REPORT – 2014

Study NDPMC-P-1103-WI

Study Title: Evaluation of Mongolian Scots Pine *Pinus sylvestris* var. *mongolica*

Commonly available Scots pine comes primarily from European and Eurasian seed sources. It has become naturalized throughout much of the upper Midwest. The commonly available sources have a few negative characteristics such as form, growth rate, disease resistance, etc. However, Mongolian Scots pine, *Pinus sylvestris* var. *mongolica*, seed collected in and around Heilongjiang Province (Nenjiang, Kedong, Bayan, Shangzhi) as part of a tree improvement program in China, has performed well over the past 14 years at multiple locations in Minnesota, North Dakota and South Dakota. It has exhibited higher vigor, insect, and disease ratings than commonly available Scots pines.

Originally this Mongolian seed source was valued in America for its more rapid growth (up to 2 feet per year at one Minnesota location), its denser foliage, and apparent increased disease and insect resistance. Perhaps this particular Mongolian source is resistant to pine wilt, caused by the pine nematode *Bursaphelenchus xylophilus.*

The nematode is native to North America and causes no damage to native pine trees. Over the past decade it has proven devastating to introduced pines such as Austrian and Scots pine planted in America. It has also been quite damaging to pines in their native ranges in China and Europe. Late in 2013, Bismarck PMC staff learned of a Chinese study to test assorted sources of pine for resistance to pine nematode. The 1989 Chinese study showed Mongolian pine as relatively resistant to pinewood nematode. An earlier Chinese study listed Mongolian pine as being susceptible to the nematode. The different study results could very well be a result of different seed sources or different strains of the nematode. As of 2015 there is no evidence of the nematode in North Dakota. The Bismarck PMC has provided Mongolian source Scots pine to Kansas and Missouri in the heart of the nematode devastation to check performance.

2012
Seed was collected from Mongolian pine in Off Center plantings at Grand Rapids, Becker, and Morris, MN. These seeds were processed, grown by Towner State Nursery and will be available for field planting in 2013. A portion of these seedlings have been made available to Kansas and Nebraska, in the heart of the nematode epidemic. Nearly 30 different locations in 5 states will receive material this year for field evaluation. A like number of seedlings will be available for next year. If annual field evaluations show decline or die off, samples should be sent to a diagnostic lab to determine if death was caused by the nematode.

2013
Distributed 625 seedlings to 25 landowners in MN, ND, and SD for field plantings. Seedlings were grown by Towner State Nursery from seed we collected and processed in 2012.

2014
Distributed 500 seedlings to 20 landowners in MN, ND, and SD for field plantings. Seedlings were grown by Towner State Nursery from seed we collected and processed in 2012.

The seed orchard at the Grand Rapids Off-Center Evaluation Planting was removed by the university. This places a greater need for the PMC to continue developing the seed orchard in Panel A at the PMC. Trees from different seed sources have been growing for several years. Each is marked with a stamped aluminum tag pop-riveted to a fiberglass stake. Due to some tree mortality caused by burrowing rodents, control in 2015 will be a high priority.

MAJOR SEED SOURCE STUDIES AND ASSEMBLIES: TECHNICAL REPORT – 2014

Study NDPMC-P-1403

Study Title: Evaluation of Douglas fir *Pseudotsuga menziesii*

From observation and conversation with foresters and others around the state, we note that there are four stands of Douglas fir in North Dakota old enough to indicate adaptability to our climate.

1. Agricultural Research Station, Mandan, ND 80-90 years old with tallest trees reaching 65 feet tall, growing on a sandy loam soil.
2. Hillside Park pool area, Bismarck, ND, 63 years old, 30-35 feet tall growing on loam soils.
3. Denbigh National Forest, southwest of Towner, North Dakota; Trees established in the 1930's growing on high water table sands with cones too high to be harvested by readily available boom lifts.
4. Wheatland cemetery, on the northeast edge of Wheatland, North Dakota, 60 or more years old, growing on sandy loams of glacial Lake Agassiz beach ridges.

These four Douglas fir plantings are quite isolated from any other potential sources of Douglas fir pollen, therefore, progeny from these sources should grow true to the genetics of the parent plant's North Dakota climatic adaptability.

There are other plantings doing well that are not as old, Bowman-Haley recreational area in southwest North Dakota; Williston Research and Extension Center in northwest North Dakota. Additional reports of individual trees doing well in isolated plantings or urban areas have also been received.

With the ever increasing threat of exotic pests, it would be beneficial to have another tree species to add to the Field Office Technical Guide. If successful, Douglas fir would represent an entirely different genus, which should improve resilience to pests and pathogens that could affect our existing list of conifers.

This species would be a good candidate for a full-fledged study. It has the potential to add a climatically adapted tall tree species to the Field Office Technical Guide. It appears most adapted to western Dakotas which has few adapted tall tree species for erosion control, snow management, energy conservation, or wildlife woody habitat cover.

2013

A boom lift was used to harvest cones from the 4 producing trees in 2013. The 50-foot boom still did not reach the top 10-15 feet of tree which contained 40-50% of the cones. Harvest occurred about 3 days too late since with each cone pulled from the tree a cloud of seed rained to the ground. The 9 gallons of cones from ARS yielded 14.1 g. of clean seed (just over 1000 seeds) that will be grown by Towner State Nursery for field planting in 2015.

2014

No cones set on the trees at the ARS location. Cones were harvested from a 63-year-old stand of Douglas fir just a few feet southwest of Hillside Park Swimming Pool in Bismarck. A boom lift was used to harvest 3 bushels of cones that yielded 487 grams clean seed. Some of the seed was provided to Towner State Nursery to grow approximately 500 seedlings for distribution for field plantings in the spring of 2016.

TECHNOLOGY DEVELOPMENT

TECHNOLOGY DEVELOPMENT: TECHNICAL REPORT – 2014

Study NDPMC-T-1303

Study Title: Cottonwood Restoration Method Evaluation

Objective: To determine an economical, effective method to reestablish native cottonwood on dewatered flood plains in the Northern Great Plains.

Introduction: Damming of major interior streams within the Great Plains has altered the hydrologic regime of entire river systems. In the free flowing reaches, water tables have dropped while areas above the dams have experienced flooding for long periods of time. Both situations are beyond the norm for cottonwood establishment. For the Missouri River reach below Garrison Dam and above Bismarck, the level of the river during the summer can be as much as 10 feet below the land surface adjacent to the river. "Model calculations predict that without changes to the current management regime cottonwood forests in the Garrison reach of the river will essentially be lost as a significant community on remnant floodplains in less than a century." (Johnson 1992)

Additionally, upland grasses such as smooth bromegrass *Bromus inermus*, and reed canarygrass *Phalaris arundinacea*, have created dense sods covering much of the previously flooded riparian forest. The dense sod and deeper soil water make natural recruitment of cottonwood impossible.

Numerous groups and individuals have attempted cottonwood restoration within the old floodplains of highly regulated rivers with mixed success. Methods have included managing soils and vegetation for natural regeneration from locally dispersed seeds; planting bare root seedlings via traditional methods; planting unrooted cuttings ranging from 8 to 30-inch lengths; and irrigating bare soils during and after the time of cottonwood seed dispersal, to name a few.

Cooperators: The USDA Natural Resources Conservation Service, Plant Materials Center (PMC), Bismarck, North Dakota, in cooperation with The Nature Conservancy (TNC), Cross Ranch Preserve.

Location: The Nature Conservancy, Cross Ranch Preserve, 1401 River Road, Center, North Dakota.

Rationale: This study evaluates three cottonwood planting materials/techniques to reestablish cottonwoods on sandy, dewatered areas that had previously been flood plains. The study is a complete block randomized design. The impacts of fabric weed control will also be evaluated by "protecting" half of each stock type in each of the four blocks with 6-foot x 6-foot weed control fabric squares. The theory behind the fabric treatment is that the deep pot plant stock will be planted with the root mass below the average rooting depth of the existing smooth brome sod. The 6-foot unrooted cuttings should develop most of the roots below the root mass of the smooth brome. To determine if the above rooting scenarios really occur, half the stock will be treated with 6-foot square weed control fabric. This should show if rooting below the brome will eliminate the need for weed control with those stock types. If it is not needed, establishment cost can be reduced by $5-$10 per tree. A marked difference in survival and growth is anticipated with respect to the fabric on the conservation stock.

Randomized Complete Block Design

Three stock types and planting methods are being evaluated using individual plant plots. There are six replications of each treatment per block. Each of four blocks are located at different elevations above ground water. The 36 trees in each block were planted on 8-foot x 8-foot spacing.

Plant Stock (Material)

Deep pot planting techniques consist of cottonwoods grown in pots that have 3-6-inch diameters and are 14-36 inches deep. Traditional potted material is then planted so the top of the root ball is at the soil surface. The intent of this planting method is to place a large mass of very active roots in the soil capable of capturing any water or nutrients that are within reach. The larger root mass should keep the material alive until active root growth can begin supporting the top growth. This method has been used for riparian restoration projects in New Mexico and Montana.

This study is different from those in the other states in that this material was not placed within the capillary fringe of a water table on the edge of a stream and the planting area is not subject to flooding, even from 500-year storm events. For this study, the deep pot material consists of 3.5-foot to 5-foot cottonwoods growing in 4-inch x 4-inch x14-inch pots planted so that the top of the root ball is 3 feet below the soil surface. It is hoped that the dense root mass below the roots of the bromegrass will initiate growth and expand to the capillary fringe of the water table. Unrooted cutting material consists of dormant cottonwood stock that has all limbs and apical buds removed. The material is harvested when dormant, and then frozen until ready for use. Unrooted cuttings range from ½-inch diameter to 1.5-in diameter and usually are 12-36 inches long. They are often used in stream bioengineering. The base ends of the stock are drilled, augered, or waterjetted into the soil so that the base is within the capillary fringe of the growing season water table.
This study used locally harvested wild material processed into 6-foot long cuttings. This is a much longer length than used in most bioengineering projects. The cuttings for this project will be waterjetted into the soil until only 1-2 buds are above the soil surface. Base end of the cutting will be planted 5.5 feet deep. Longer material was not used because 5.5 feet is about the maximum length of a waterjet stinger that a person can handle.
Containerized conservation grade stock commonly will be used as the control. There will be no replanting of stock that dies.

Stock Preparation and Handling Procedures:
March 1, 2012: Planted 3-6-inch unrooted cottonwood cuttings in 4-inch x 4-inch x 14-inch pots in the greenhouse.
May 15, 2012: Moved the deep pot material to the lath house to develop wind hardiness. Trees were watered every other day on average throughout the season.
September 15, 2012: Eric Rosenquist, Wayne Markegard, and Craig Stange used a TNC wildland fire truck to determine if the waterjet stinger and a fire truck can drill holes to a 5.5-foot depth in sand. It can, within a few seconds, but the sand refills the hole once the water stream stops. This problem can be alleviated by grasping the cutting next to the waterjet stinger and working both into the soil at the same time.
November 10, 2012: Deep pot material was pulled out of stands and laid over, along with other lath house material, on a heavy white plastic. Mice baits were scattered amongst the trees. The heavy plastic was folded over trees and edges sealed with boards and concrete blocks. Later in the month, 6 inches of wet heavy snow was scooped onto the plastic.
February 7, 2013: PMC staff harvested and processed about 80 native cottonwood cuttings from a nearby wetland. Material was cut to a 6.5-foot length allowing 6 inches to be cut off the base end just prior to planting in the spring. Material was frozen at Lincoln-Oakes Nursery.
May 7, 2013: Unrooted stock was removed from Lincoln-Oakes Nursery cooler and allowed to warm to near room temperature. The lower 6 inches of each cutting was cut off at a sharp angle. The sharp angle was an easy way to determine the bottom of the cutting at planting time.
May 21, 2014: All stock types except unrooted cuttings were handled the same way as the previous year. Took delivery of unrooted cuttings from Lincoln-Oakes Nursery. They were multi-branched trees about 8 feet long. Lateral branches were removed. 4-6 inches of the base was cut off at an angle and the top cut at 6 feet from the base. Cuttings were stored with base ends in water and the tops wrapped in plastic in the tree cooler.
May 22, 2014: Deep pot stock was collected from the lath house and the most robust 36 plants were selected for planting. Conservation stock from Big Sioux Nursery was quickly looked at, left in the waxed shipping box and returned to the tree cooler.
May 23, 2014: Stock was loaded for transport and wrapped according to standard procedures to protect from desiccation on the 45-minute trip.

Site Preparation: Plans were to prepare all sites by mowing in late summer 2012 and applying glyphosate in mid-September. TNC was unable to mow the site in the fall 2012. All planting sites were prepared by mowing and glyphosate application before planting during the spring of 2013. Spring and summer 2011 was exceedingly wet. Block 1 was under 2 feet of flowing Missouri River water for about a month. There was below normal precipitation throughout the remainder of the summer and into the fall of 2011. Winter precipitation was below normal. The only major moisture event since the flood was 17 inches of wet snow in late April 2012.
May 3, 2013: The sites were mowed and a 1.5% solution of Cornerstone was applied to each block in 7 quarts of water.
May 3, 2013: Each individual tree location was marked in the field. The location of each tree within the each of the four blocks as well as whether protected by fabric or not, was determined by drawing numbers from a hat. Tree assignments began in the northwest corner of each block.

April 23, 2014: Blocks 5-7 were staked, marking each treatment and stock type.
April 24, 2014: Dense stands of dead Russian thistle from block 5 were brush-bladed. Grass and scouring rush were brush-bladed from blocks 6-7.

Tree Planting: All trees were planted according to plans.
May 7, 2013: To minimize confusion at planting time, each tree planting spot was marked with flags; orange for unrooted cuttings, pink for deep pot and white for conservation stock. Each flag was marked if weed barrier was to be applied.
May 8, 2013: Unrooted cuttings were waterjetted to a 5.5-foot depth as planned. The larger diameter stock and stock with crooks in the stem proved more difficult and took longer to jet into the ground. Care was taken to ensure that the base ends were planted down. It was estimated that about 4 gallons of water were used to jet the holes. The top of each waterjet hole was pressed closed by stepping on the hole. (*Note: It was anticipated that these cuttings would be long enough to have reached the water table because pre-study site investigation showed soil mottling at 30-40 inches in each of the 4 study blocks. It was not until much later that we learned that soil mottling will remain for many decades after the fluctuating water tables that caused the mottling have been lowered. The mottling probably developed when the area was subject to flooding, prior to the closure of Garrison dam in 1953. With the downcutting of the river channel since dam closure, the sites have been dewatered.)*
Deep pot material was planted in a hole drilled 4 feet deep by a tractor powered post auger. The hole was cleaned to a precise 4-foot depth with hand posthole diggers. (That is the maximum depth the tractor driven auger could dig.) Deep pot material was removed from the pot and gently lowered to the bottom of the hole. Soil was lightly tamped around the root mass to the top of the root ball. About 4 gallons of water were added to the hole after tamping to keep treatments similar to the water added with the water jetting. Once the water soaked away, soil was gently tamped in the hole filling it to the surface. Most of the deep pot material had 10-18 inches of live stem above the soil surface after planting.
Conservation stock was hand planted with a shovel. Since the vegetation had been killed by herbicide, no scalping was done. The hole was dug large enough to easily accommodate the 20-in^3 root ball. After planting, about 4 gallons of water were slowly added to the planting site to equalize with the other planting methods. Most conservation stock was 12-18 inches tall at planting.
Monitoring test wells were hand installed in the middle of each block by employees of the North Dakota State Water Commission and the staff forester on the same day the trees were planted. Test wells were hand augured to 12 feet deep. A 1.5-inch diameter PVC pipe with 2-foot screen on the bottom was placed in the hole with sand for the lower 10 feet and bentonite clay for the upper 2 feet of the hole. A cap on the top kept debris out and was easily removed for measuring tape access. Water depths at planting were: Block 1, 8.0 feet; Block 2, 10.4 feet; Block 3, 8.2 feet; Block 4, 10.0 feet. Due to the coarse textures of the soils, it is unlikely that any of the stock reached the capillary fringe of the water table. However, it is possible that the varied layers of different soil textures within the profile may have perched water tables that provided a bit of moisture.
Four-foot tree shelters were installed on each tree to protect from deer browse. Some of the tree shelters were supported with white oak stakes and some were supported with ¾-inch PVC electrical conduit. One-half of each tree stock type within each block had a six-foot fabric square installed to control weeds. Fabric squares were anchored at the corners with 2-inch x 8-inch 9-gauge staples.
May 23, 2014: Planting, fabric installation, and tree shelter installation were performed in the same manner as the previous year. The borrowed pumper truck had mechanical issues and delayed the water jet planting process 2-3 hours. Conservation stock and deep pots were planted with most of the fabric and tree shelters installed while awaiting the fire truck so that unrooted cuttings could be planted. When digging deep pot holes (4-foot deep with an 8-inch post hole auger) on block 7, the top of the water table was above the bottom of the hole. When planting the unrooted cuttings, the unrooted cutting floated in the hole on blocks 6 and 7. The top of the hole was stomped shut to prevent floating. The scouring rush roots greatly complicated planting the unrooted cuttings. The fins on the waterjet were unable to easily create a large enough opening for the waterjet plus a cutting nested against the pipe. In 3-5 cases, the tops of the cuttings were left 12-18 inches above the soil surface.

Maintenance
June 21, 2013: Brush blades were used to cut thistles and weeds that were growing through the herbicide site preparation. Block 1 in the old overflow channel was a solid stand of Canadian thistles 3-4 feet tall. Mowing them down was mostly for access and public relations. The thistles in block 1 were a direct result of the 2011 flooding. The entire overflow channel was solid thistles. Tall herbaceous vegetation was also mowed on the other plots to keep treatments equal. Due to the sandy nature of the soil, proximity to water tables, and the public exposure, no

herbicide application was done for thistle control. The North Dakota Ag Weather Network monitor at Hazen, approximately 12 miles away, recorded 8.65 inches of precipitation in April of the planting year.
June 3, 2014: Installed test wells with Scott Parkin from the State Water Commission. Applied glyphosate to emerged vegetation on blocks 5-7.

Observations and Measurements

2013

The following was observed (no statistical analysis at this time).

- The deep pot plant stock grew the tallest and had the best survival with and without fabric.
- The conservation stock had much better survival than anticipated with a slightly better growth where weeds were controlled with fabric.
- The unrooted cuttings had around 20% survival and height growth was considerably less than the other treatments. Surprisingly, the unrooted cuttings with fabric performed slightly better than those without fabric.

2014

The following was observed. No statistics have been run, but some charts have been included to illustrate what has been observed to date.

- Blocks 1-4 continue to show low survival on the unrooted cuttings, slightly better when protected with fabric. Any apparent resurrection of dead plants to live plants a year later is most likely an error of measurement or a resprout from the base of a dead top. See Figure CR-1.
- A perplexing phenomenon was observed in July of 2014. The deep pot plants with fabric had over wintered with a "normal" over winter mortality, just like all the other stock types and treatments. However, between May and July, this stock type dropped from 92% survival to 67%. That did not happen to any of the other stock types nor any of the others with fabric. Why only that stock type under fabric showed mortality is a mystery. See Figure CR-1.
- By the end of 2014, most of the treatments had grown to the top of, or out of the 4-foot tree shelters. As more plants grow out of the reach of the deer, there should be a rapid increase in growth. The deep pot stock, with and without fabric, exhibited the most height growth. With conservation stock not far behind. See Figure CR-2.
- Blocks 6-7 were sited to ensure that the water table was within 5 feet of the soil surface to test the ability of unrooted cuttings to become established.
- The survival summary of these 3 blocks showed lowest survival on the conservation stock with highest survival on the deep pots. Unrooted cuttings established only slightly less successfully than the deep pots. Fabric weed control seemed to have the most beneficial impact on the conservation stock. See Figure CR-3.
- Surprisingly, the unrooted cuttings with fabric showed the greatest height growth. See Figure CR-4.

Future Plans

2014

TNC and PMC staff will replicated this study in 3 additional blocks. The new areas have been selected to ensure that at least 2 of the blocks will be positioned where the unrooted cuttings will reach the water table. The 3rd block will be situated on a high dry sand dune to really test the ability of the deep pot stock to survive and grow. Site preparation, stock types, planting, deer protection and weed control was the same as with the original 4 blocks. Tubes, stakes, fabric squares and staples were removed from the dead stock in block 4 and used at the new planting sites. Monitoring of the original 4 blocks will continue through the growing season. Sometime during 2015 or 2016, staff should excavate adjacent to a few trees of each stock type to determine root placement. Questions yet to be answered include: has the root ball on the deep pot material continued to initiate the bulk of the roots on the plant or have lateral roots initiated on the stem and a dense root mass developed closer to the soil surface where more soil oxygen is present? Where are the roots on the unrooted cuttings? If the base end was in a saturated water table, it would be logical that few if any roots would have developed at that depth. However, on these sites with no saturation, was there uniformly dense root development along the entire cutting? Did the conservation stock send many or just a few roots deep in the soil?

2015

Continue collecting data on survival and growth. As needed, raise shelters enough to see if the base of the plant is truly dead. If time allows, use backhoe to excavate some of the dead deep pot sites to determine if root origination and development affected mortality.

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Johnson WC, Dixon MD, Scott ML, Rabbe L, Larson G, Volke M, Werner B. 2012. Forty Years of Vegetation Change on the Missouri River Flood plain. BioScience 62:123-135.
Tilley, DJ, St. John,L, 2012. Cottonwood Planting Depth. Idaho Plant Materials Center Technical Report 1104-RI.
Deep Planting – The Ground Water Connection, Los Lunas Plant Materials Center, Natural Resources Conservation Service.
Hoag, JC, Simonsen, B, Cornforth, B, St. John, L, 2001. Waterjet Stinger: A tool to plant dormant unrooted cuttings of willows, cottonwoods, dogwoods, and other species. Idaho Plant Materials Center Riparian/Wetland Project Information Series No. 17, June 2001.

Figure CR-1.

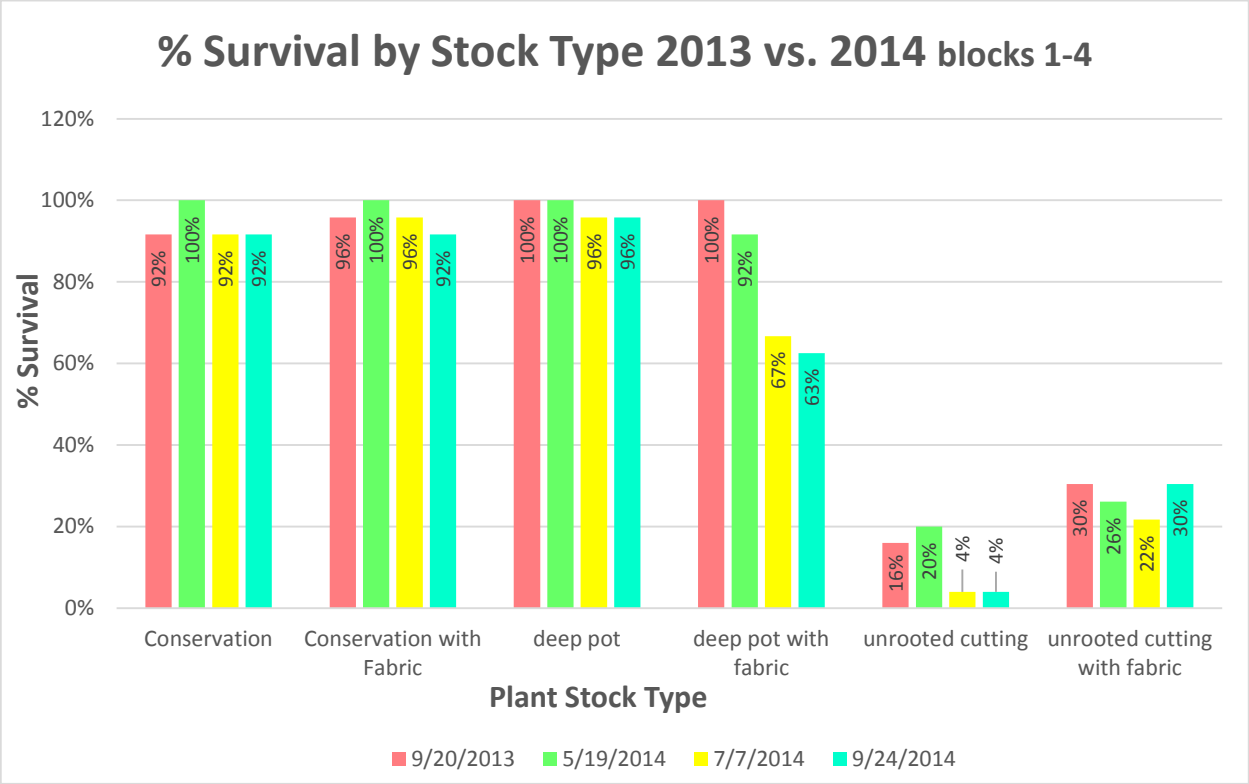


Figure CR-2.

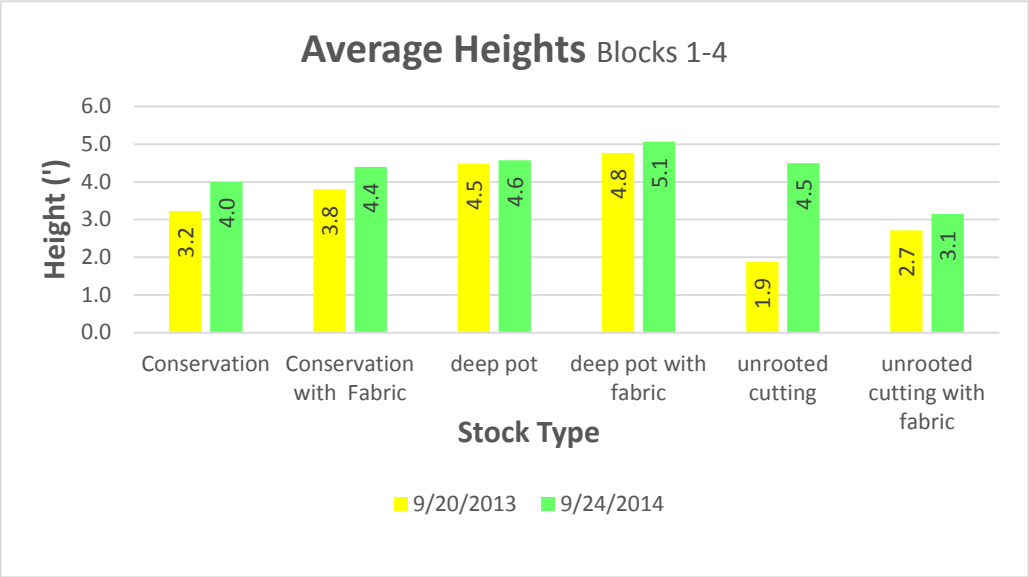


Figure CR-3.

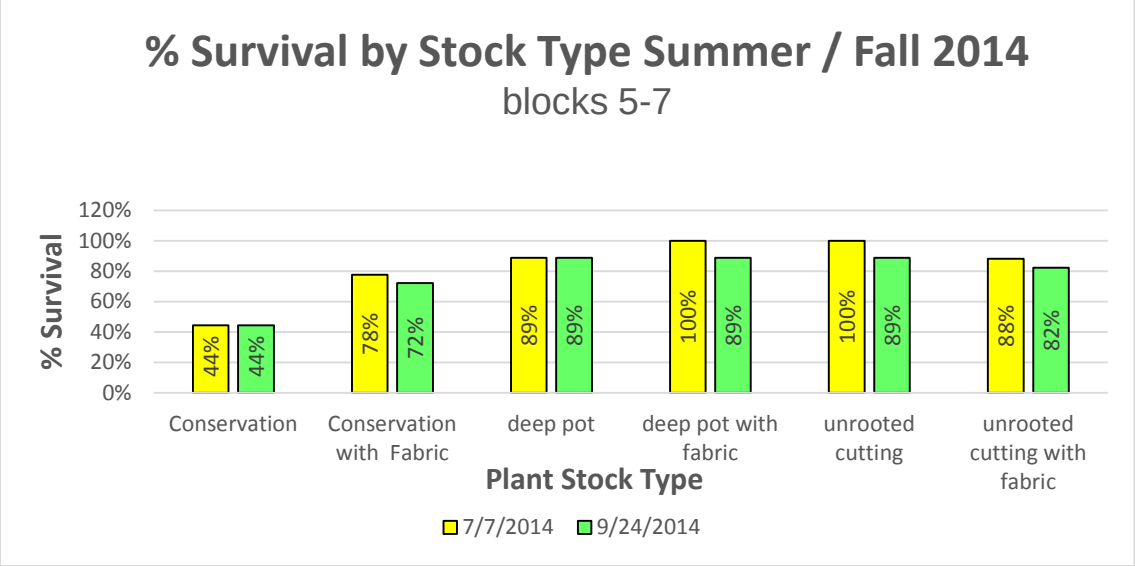
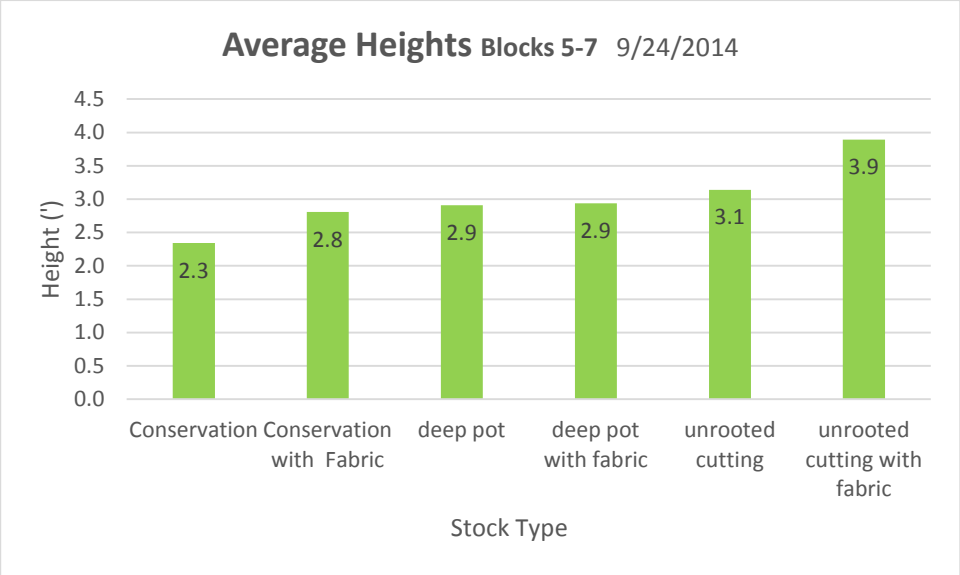


Figure CR-4.


Average Heights Blocks 5-7 9/24/2014
Height (')
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
2.3
2.8
2.9
2.9
3.1
3.9
Conservation
Conservation with Fabric
deep pot
deep pot with fabric
unrooted cutting
unrooted cutting with fabric
Stock Type

TECHNOLOGY DEVELOPMENT: TECHNICAL REPORT – 2014

Study NDPMC-T-1402

Study Title: Hybrid Poplar Salinity Tolerance Evaluation

Introduction: Saline soil conditions affect all manner of growing plants. According to Bruce Seelig (2000) 1.9 million acres of North Dakota are affected by sodicity and 700,000 acres are affected by salinity. Too often building sites and roads are located on or adjacent to saline soils. This salinity limits or precludes the use of agroforestry practices (tree and/or shrub planting) to moderate winds, trap and manage snow distribution, and reduce energy demands for snow removal, livestock feed, and building space heating. For those locations where saline soils prevent woody plant survival and vigor, cooperators are often left fully exposed to the snows and winds of winter. Only a few species are currently adapted to saline soils. Most are shrubs. The lone salt tolerant tree is Russian olive *Eleagnus angustifolia* which has found much disfavor with many land managers due to its invasive characteristics.

Salinity in the field is difficult to measure. It varies between seasons and within a single season (Ulmer 2013). A short period of drought or wet weather can change salinity levels on any given site. Additionally, many saline sites will be affected by sodicity (Weiser 2013). Sodicity occurs when one of the salts causing the salinity is sodium chloride. The sodium causes a layer of nearly impervious soil to develop just above the saline salts. The impervious layer is caused by the sodium dispersing the soil particles so they fill many of the voids reducing the availability of soil oxygen and greatly reducing water infiltration rates. The sodium ion itself is also directly toxic to the plant.

The US Forest Service based in Rhinelander, Wisconsin, provided 7 clones of hybrid poplars that have exhibited saline tolerance to 9 mmhos (Zelesny 2013). Originally these clones were developed for biomass, bioenergy, and bioproducts. They were most recently tested and selected for use on bioremediation sites to uptake soil pollutants. If they were to perform satisfactorily at even half that salinity, it would be better than all but a few of the trees currently available for conservation planting in ND. These poplars were grown for differing lengths of time outdoors in the Rhinelander area, exhibiting adaptation to cold temperatures. Due to the Wisconsin location, salinity had to be created in a lab and applied to the trees through irrigation water. It was our intent to establish a field trial with these plants where local salinity is comprised of a wide assortment of minerals and most likely compounded by sodicity and wetness, a situation that is fairly common across the Northern Great Plains.

Objective: To determine salinity tolerance of the Rhinelander hybrid poplar clones in North Dakota field conditions.

Rationale: If these hybrid poplars perform well on very slightly saline, slightly saline and moderately saline soils, they will be a useful addition to our Field Office Technical Guide for agroforestry plantings in saline areas. Successful plantings could reduce salinization through reduced soil surface evaporation and greater transpiration. They would capture more snow which may further dilute surface salinity while providing protection to roads and building sites.

Study Design: Each salinity range, very slightly saline (0-3.9 mmhos), slightly saline (4-5.9 mmhos), and moderately saline (6-10 mmhos) contained seven plants of each of the seven saline tolerant hybrid poplars, seven plants of Robusta poplar and seven plants of Russian olive. Irregularity of the site made it impossible to break the planting into “blocks” of uniform salinity. This prevented the study being laid out with three distinct reps. The “statistical reps” were determined by 3 individual drawings of plant accession numbers from a hat and marked on the map and planted on the site as described above.

Utilizing a Field Scout EC Meter manufactured by Spectrum Technologies Inc. and a soil scientist skilled in mapping saline soils, nearly 400 survey flags were initially located on a 10-ft x 10-ft grid covering the area most likely to include the desired salinity ranges. The salinity meter was calibrated using the solution provided by the manufacturer. Measurements were be taken near each flag. (Note: Flags were all plastic, including the shaft, to ensure salinity measurements were not affected.) Measurements were recorded at 3-inch and 9-inch depths. The readings were recorded on the flag and on paper. The 3’-depth readings did not provide enough of the higher salinity spots, therefore initial design and plot layout was based on salinity readings from the 9” depth. Once the area had been gridded, each spot on the paper was colored as to one of the three salinity ranges. Beginning in the southeast corner of the test area 63 spots (plots) were assigned to each of the three salinity ranges. This process was

repeated for each of the three reps. There were more of the lowest initial salinity ranges than the others so as plot assignments continued westward in the study area, there were skips where a tree was not planted on a very slightly saline spot. Three different colored flags, one color for each salinity range, were placed at each of the appropriate spots on the ground to ease planting efforts.

Individual plant locations for the 63 plants within each of the three blocks was determined by drawing accession numbers marked on metal washers from a hat. This was done for each of the three blocks. Drawn numbers were assigned positions beginning with the southeast corner of the study area and progressing east to west. Each north-south row numbering began from the south side. In other words, the individual tree plots were not numbered in a zigzag serpentine fashion from row to row.

Plant Stock (Material): All experimental planting stock, except the Russian olive control, was started from 6-8-inch unrooted cuttings in 16-inch^3 conetainers and after 6-8-inch growth transplanted to 4-inch x 4-inch x 14-inch deep pots. The Russian olive was conservation grade stock ordered the spring of establishment. The Russian olive tree stock was very dry with few fine roots and rather "wimpy" when delivered.

Site Preparation: No weed control was applied prior to planting since removing vegetation through tillage or herbicide would increase surface salinity through increased evaporation and salt deposition. If vegetation at each plot was mowed short with a brush blade.

Tree Planting: Planting depth to the bottom of the root ball was 12-13 inches. As expected, the soils of the sites were very sticky. A putty knife was used to scrape the goo off the shovel after each dig. In order to obtain good root soil contact, each planting hole was backfilled with Mandan silt loam brought to the site from the Plant Materials Center. All experts consulted felt that the in situ salinity would equalize across this added soil within one growing season.

Maintenance and Protection:
2014
The area is subject to very heavy deer browse and is grazed by cattle every other year. Five-foot tree shelters were installed by evening of the planting day to protect from deer. The area was not grazed in 2014. Corner posts and line posts with insulators were installed summer of 2014. A single strand electric wire and energizer will be installed spring of 2015 before cattle are released to the pasture.

Observations and Measurements:
The planting will be observed every two-four weeks with salinity, survival, tree height, temperature and moisture measured at each plot. Note that there are 73 plots were no trees and no fabric were planted or installed. These sites will be monitored to see how salinity changes over time without fabric. There may or may not be an impact on salinity caused by fabric and growing trees. At least one set of measurements should be taken in mid to late May to determine over winter survival and one set should be taken in mid-September to determine growing season survival. Other measurements throughout the season will give a more precise picture of salinity fluctuations and tree response. Measurements should include at a minimum: salinity, tree survival, tree height, any unique observations.

2014
Individual aluminum identification tags were embossed with the accession number and plot number for each tree. These were attached with pop rivets to the PVC stake supporting the five-foot tree shelters. This should allow positive identification of each tree.
May 15: Initial salinity readings to determine plot locations.
June 10: Planted trees and installed tree shelters.
July 7: Recorded salinities at each plot.
July 15: Recorded salinity, height, survival, % moisture, and temperature at each plot.
July 16: Pulled 22 soil samples, from adjacent to trees, for analysis and to compare to salinity meter.
August 27: Recorded salinity, height, survival, % moisture, and temperature at each plot.
October 22: Recorded salinity, height, survival, % moisture, and temperature at each plot.

Measurements have not been statistically analyzed, but the following was observed:

- Across all plots the salinity readings at 9-inch depth generally decreased as the season progressed. If a site showed substantial spike it may well have been a poor reading caused by the additional PMC soil, or bad contacts between the probe and the soil.
- A few trees were showing burned leaf margins by mid-July on the "hotter" plots.
- In early July, 3 plants from accession 9094426 exhibited 50% top dieback. Interestingly, this same accession showed the same symptoms in the left over stock growing in our lath house.
- Comparing the 22 soil samples to the probe readings at that site and time were inconclusive.

Future Efforts:

Long term

Before the Russian olive produce seed, they will be removed and the stumps treated. As trees die, fabric, tubes, and staples will be removed by Plant Materials staff. Stakes with identification labels should be left on site to ensure positive plot identification. Once the study has concluded, protective materials can be left or removed as deemed appropriate by the landowner.

Findings shall include the success or failure of various hybrid poplar clones to establish on saline sites typical of the upper Great Plains, as well as any other unique characteristics that become apparent as the study progresses. Specific clones tolerant of very slight to slight salinity conditions could be added to the Field Office Technical Guide. Research results will be provided to partners and peer groups as well as other PMCs and field offices throughout the Great Plains.

2015

Continue regular measurements to monitor changes in salinity and impacts on tree growth.
Work with a soil scientist to pull soil samples from a precisely measured depth and compare to the electronic meter readings.
Install permanent plot stakes with identification on the grass only plots.

References:

Seelig, B. 2000. Salinity and Sodicity in North Dakota Soils. NDSU Extension Service.
Ulmer, M. 2013. Personal Communication. Retired Soil Scientist, Natural Resources Conservation Service, Mandan, ND.
Weiser, H. 2013. Personal Communication. Agronomist and Former Soil Scientist, Natural Resources Conservation Service, Jamestown, ND.
Zelesny, R. 2013. Personal Communication. Research Geneticist, Northern Research Station, USFS, Rhinelander, WI.

SELECTION AND INCREASE

SELECTION AND INCREASE: TECHNICAL REPORT – 2014

Promising Woody Plant Material

The following accessions show potential for further evaluation and potential release:

Genus/species	Accession Number	Origin	Remarks
Roundleaf hawthorn *Crataegus chrysocarpa*	9076678	5 South Dakota counties	Field plantings, seed increase, Serious fire blight threatens the existence of this planting.
Bur oak *Quercus macrocarpa*	TBD, composite	Several states	Selected from ARS nursery. Culls have been removed and the canopies raised.
Chokecherry *Prunus virginiana*	TBD	TBD	NDSU breeding program
Chokecherry *Prunus virginiana*	9008183	Sheridan County, ND	Future is uncertain.
Black cherry *Prunus serotina*	9076737	Faribault and Anoka Counties, MN	In field plantings. In ND, SD, and MN FOTGs
Skunkbush sumac *Rhus trilobata*	TBD	TBD	Study will be removed in 2015.
Common ninebark *Physocarpus opulifolius*	9082891	IA (seed source)	Field plantings, from Big Sioux Nursery, Watertown, SD.
Meyers spruce *Picea meyerii*	9094411	China	Field plantings. Proving to be more difficult to establish.
Mongolian Scots pine *Pinus sylvestris* var. *mongolica*	9094403	China	Field plantings, composite of 9063158, 9069172, 9076719, 9076718, 9069164. These seed sources may be resistant to pine nematode.
Lodgepole pine *Pinus contorta* var. *latifolia*	9094433	Colorado to Canada	Has performed well at ARS and in two 7-year trials in ND. Will initiate Off-Center testing and field plantings in 2014.
Douglas fir *Pseudotsuga menziesii*	9094341 9094342	Unknown Unknown	80-year-old trees at ARS; 40-plus year old trees at Hillside Park in Bismarck. Towner State Nursery is growing out seed for OCEP and 2015 field plantings.