



United States Department of Agriculture
Natural Resources Conservation Service

Plant Materials Center
Bismarck, North Dakota

Technical Report, 2011-2012

Part 1 of 2: Grasses, Forbs, and Legumes

Big bluestem
Andropogon gerardii



USDA-NRCS PLANTS Database / Hitchcock, A.S. (rev. A. Chase). 1950. *Manual of the grasses of the United States*. USDA Miscellaneous Publication No. 200. Washington, DC.

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

Technical Report

Part I (Grasses, Forbs, and Legumes)

2011-2012

Plant Materials Center Advisory Committee

Mary E. Podoll, State Conservationist, North Dakota
Janet L. Oertly, State Conservationist, South Dakota (retired 2011)
Paul Flynn, Acting State Conservationist, South Dakota (2012)
Don A. Baloun, State Conservationist, Minnesota

State Resource Conservationists

Todd A. Schwagler, North Dakota
Gerald Jasmer, South Dakota
Paul A. Flynn, Minnesota

Plant Materials Specialist

Dwight A. Tober, Bismarck, North Dakota (retired Sept 2011)
Wayne Markegard (Nov 2011 –Present)

Plant Materials Center Personnel

Wayne L. Duckwitz, Manager
Craig M. Stange, Forester
Nancy K. Jensen, Agronomist
Earl G. Aune, Biological Science Technician (Foreman)
Michael D. Bellon, Biological Science Technician (Jan 2011 to Aug 2011) (EOD Sept 2012)
Rachel H. Bergsagel, Biological Science Technician
Janet M. Caolo-Tanski, Biological Science Technician (Sept 2011 to Aug 2012)
Julius C. Saylor, Office Automation Clerk (EOD Sept 2011)
Dennis DeVault, Seasonal Biological Science Aid (2011, 2012)
Ryder A. Schwagler, Seasonal Biological Science Aid (2011)
Kyle Wolf, Seasonal Biological Science Aid (2011)
Kevin M. Cortes, WAE, Seasonal Biological Science Aid (2012)
Brandon C. Alvshere, WAE, Seasonal Biological Science Aid (2012)
Teal R. Jacobson, WAE, Seasonal Biological Science Aid (2012)

PART I
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INTRODUCTION

INTRODUCTION: TECHNICAL REPORT – 2011-2012

Plant Materials Priorities and Needs

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.

Objectives and Functions

1. Identify, select, and improve plants to meet the resource conservation needs of the three States.
2. Determine cultural techniques for successful propagation and establishment of these plants.
3. Assemble and comparatively evaluate materials on and off the PMC.
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, which is made available to commercial seed growers for establishing seed increase fields.
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.

**PLANT MATERIALS CENTER LONG RANGE PLAN
BISMARCK, NORTH DAKOTA
2006-2010**

I. Introduction

The mission of the Plant Materials Program is to develop and transfer effective state-of-the-art plant science technology to meet customer and resource needs. The purpose of the Plant Materials Program is to carry out specialized activities in resource conservation, as part of the overall program of the Natural Resources Conservation Service (NRCS). It is the responsibility of the Plant Materials Center (PMC) to:

1. Assemble, test, and release plant materials for conservation use.
2. Determine techniques for the successful use and management of conservation species.
3. Facilitate the commercial increase of conservation species.
4. Provide for the development and transfer of applied plant science technology to solve conservation problems.
5. Promote the use of plant science technology to meet the goals and objectives of the USDA and NRCS Strategic Plans.

The PMC Long Range Plan (LRP) identifies, guides, and directs PMC operation toward solving high-priority resource problems identified in the States' PMC LRP. The PMC LRP is consistent with goals and objectives identified in the NRCS Strategic Plan, National Plant Materials Program Strategic Plan, and State Strategic Plans. Recommended action items and specific products are identified in individual State Annual Plans which are reviewed and updated annually.

II. Long Range Plan Development

The LRP is in accordance with the revised National Plant Materials Manual, Part 540.22. This plan acts as a guide for directing PMC activities within Minnesota, North Dakota, and South Dakota. NRCS representatives from all three states met in Fargo, North Dakota, on March 8, 2006, to determine the basis for this plan. Feedback in the form of survey questionnaires was received from various NRCS offices, conservation districts, and partners in the three States. The "*Plant Materials Program Strategic Plan Survey Responses*" publication (2/7/05) was also used to provide insight and guidance to the decision making process.

General Description of the Service Area

Climate – USDA Plant Hardiness Zones 2, 3, 4, and 5 are within the area serviced. Precipitation is quite varied both in annual amount and in seasonal distribution, and predominantly occurs in the form of rainfall. Long-term average annual precipitation varies from 12 inches to 35 inches. The growing season ranges from 95 days to 155 days. The titles of the four Land Resource Regions include:

- Northern Great Plains Spring Wheat
- Western Great Plains Range and Irrigated
- Central Feed Grains and Livestock
- Northern Lake States Forest and Forage

A detailed description of the major land resource areas, land use, and climate may be found in the reference “*Land Resource Regions and Major Land Resource Areas of the United States,*” Agricultural Handbook 296.

III. Goals

Three broad-based goals have been identified.

Goal 1:

- Identify and evaluate plants and develop technology for their successful establishment and maintenance to solve natural resource problems.

Goal 2:

- Provide plant materials and plant technology that are economically feasible for solving conservation problems and to meet emerging energy and environmental needs.

Goal 3:

- Provide equal access for all Americans to the Plant Materials Program. All products and services must be delivered fairly and equitably. Promote the increased use of plant materials to address human health, safety, cultural, and aesthetic issues.

IV. Plant Materials Priorities and Resource Concerns

Native Prairie Ecosystems Restoration

- Identify additional species and develop sources.
- Develop establishment and management protocol.
- Market PMC releases.

Warm-Season Grass Promotion and Development

- Promote economic as well as conservation benefits.
- Promote the benefits of big bluestem.
- Promote proven management techniques to minimize invasive species.
- Select a switchgrass or other native species as alternatives to smooth brome grass in grassed waterways.

Tree and Shrub Related Technology

- Increase species diversity in windbreaks.
- Identify/develop additional tall tree species.
- Identify/develop additional native shrub species.
- Identify and promote alternatives for invasive species.

Wetland and Riparian Plant Materials

- Identify/develop additional species.
- Develop establishment and management protocol.

Saline/Alkaline Tolerant Plant Materials

- Develop and distribute information.

Filter Strips/Nutrient Management

- Develop/promote effective plants for nutrient uptake.

Streambank and Lakeshore Stabilization

- Develop establishment and management protocol.

Information, Education, and Outreach

- Promote the value of PMC releases.
- Identify and promote perennial plants for wildlife food plots.
- Remarket older plant releases.
- Target specific outreach opportunities to non-traditional clientele.

Alternative and Specialized Use of Conservation Plants

- Utilize agroforestry technology.
- Recognize alternative income species.
- Promote switchgrass as a biomass fuel for energy savings.

Urban Conservation

- Provide information on effective species/varieties.
- Promote native landscaping as low energy and reduced maintenance.
- Sell the economic as well as the environmental benefits.

V. Partners and Cooperators

Plant Materials Program activities are conducted in cooperation with universities, State and Federal agencies, industries, conservation groups, soil and water conservation districts and associations, and others. The primary customers are the NRCS field offices in Minnesota, North Dakota, and South Dakota. Improved plant materials will be released with cooperating agencies, Agricultural Experiment Stations, and State crop improvement associations. Seed growers and conservation nurseries will be kept informed of the availability of new plants and production techniques.

Approved by: Bismarck Plant Materials Center Advisory Committee


WILLIAM HUNT, NRCS State Conservationist, St. Paul, Minnesota 8/31/06
Date


JANET OERTLY, NRCS State Conservationist, Huron, South Dakota 8/31/06
Date


J.R. FLORES, NRCS State Conservationist, Bismarck, North Dakota 8-31-06
Date

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 46°46'N and longitude 100°45'W.

Physical Facilities and Evaluation Sites

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

1. Lincoln-Oakes Nurseries, 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, and machine storage shed (refrigeration units), seed cleaning building, chemical storage shed, and a shop.
2. Off-center evaluation sites in Minnesota, South Dakota and North Dakota. These four other 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 plants evaluated under uniform culture and management. Refer to map, page 11.

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, Conservation Tree and Shrub Group 3.

Climatological Information and 2011-2012 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.

Precipitation averages 16.84 inches per year. 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. Refer to Table 1 for 2011-2012 weather data.

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 -44 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 in fall and winter and from the southeast in spring summer. April and May are the windiest months. The average freeze-free period is 134 days from mid-May to late September.

Table 1: 2011-2012 Weather Summary - Official Station - Bismarck, North Dakota								
Month	Mean Temperature			Precipitation (inches)				
	(degrees Fahrenheit)			Actual			Deviation from Normal	
	2011	2012	Normal*	2011	2012	Normal*	2011	2012
January	9.7	22.7	10.2	1.13	0.30	0.45	0.68	-0.15
February	12.1	22.2	18.1	0.57	0.48	0.51	0.06	-0.03
March	21.2	43.2	29.7	1.56	0.53	0.85	0.71	-0.32
April	40.1	47.1	43.3	2.35	1.71	1.46	0.89	0.25
May	52.4	55.2	56.0	2.32	1.98	2.22	0.10	-0.24
June	62.7	67.2	64.7	3.19	2.15	2.59	0.60	-0.44
July	71.6	75.7	70.4	5.24	2.65	2.58	2.66	0.07
August	69.2	67.7	69.0	4.02	2.33	2.15	1.87	0.18
September	57.7	59.0	57.7	0.96	0.05	1.61	-0.65	-1.56
October	48.9	42.7	45.2	1.35	1.02	1.28	0.07	-0.26
November	31.4	28.6	28.0	0.06	1.07	0.70	-0.64	0.37
December	25.1	15.3	15.2	0.47	0.63	0.44	0.03	0.19
Annual	41.8	45.6	42.3	23.22	14.90	16.84	6.38	-1.94
* National Climate Data Center 1971-2000 Monthly Normals								
			<u>2011</u>	<u>2012</u>				
Last Frost (28 degrees)			n/a	22-Apr				
First Frost (28 degrees)			n/a	22-Sep				
Frost Free Period			n/a	152 days				

REGIONAL DESCRIPTION

REGIONAL DESCRIPTION: TECHNICAL REPORT – 2011-2012

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

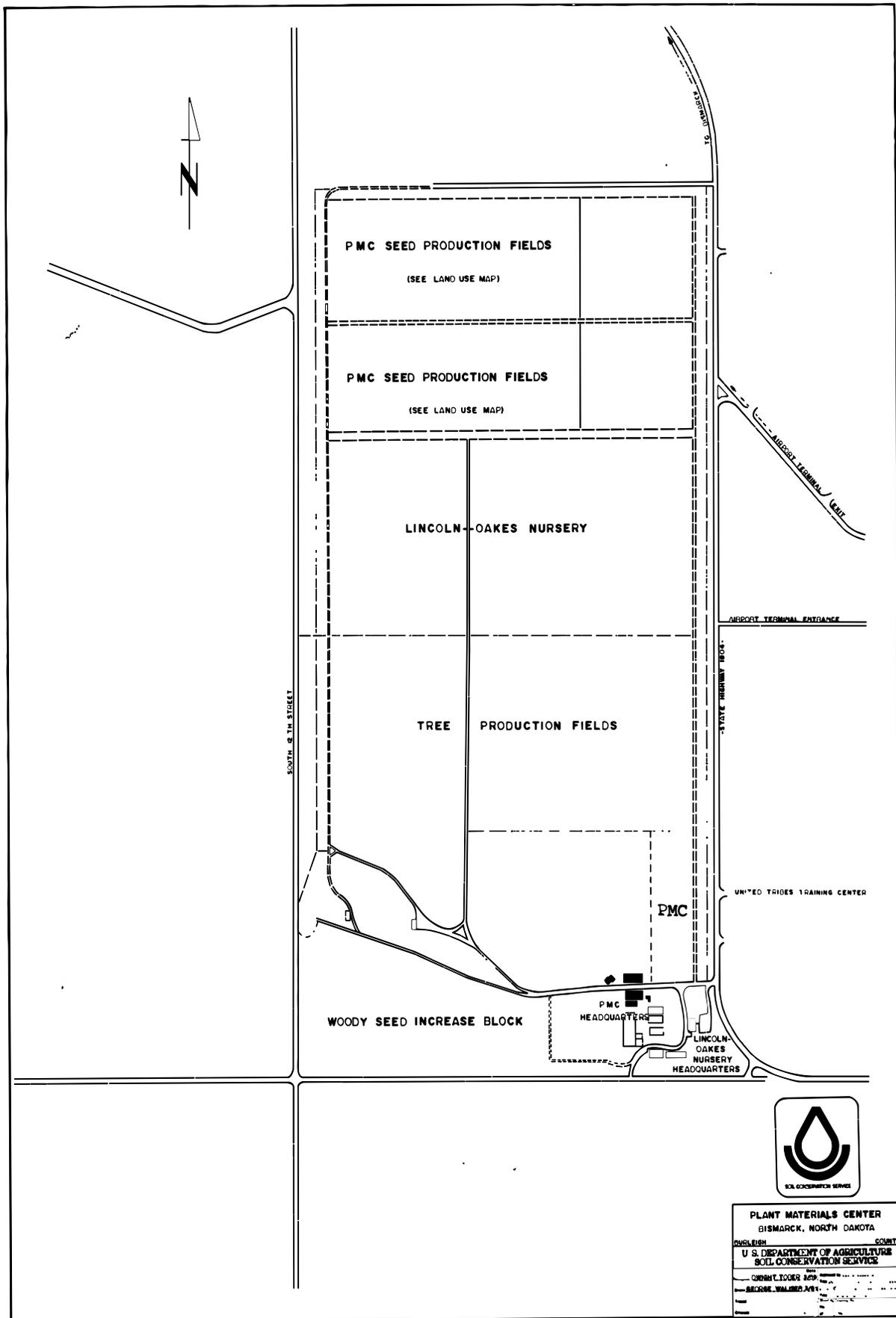
Most of central and western North and South Dakota support a mixed grass prairie of predominantly western wheatgrass (*Pascopyrum smithii*), green needlegrass (*Nassella viridula*), needleandthread (*Hesperostipa comata*), slender wheatgrass (*Elymus trachycaulus*), and prairie junegrass (*Koeleria macrantha*). 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 australis*) 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

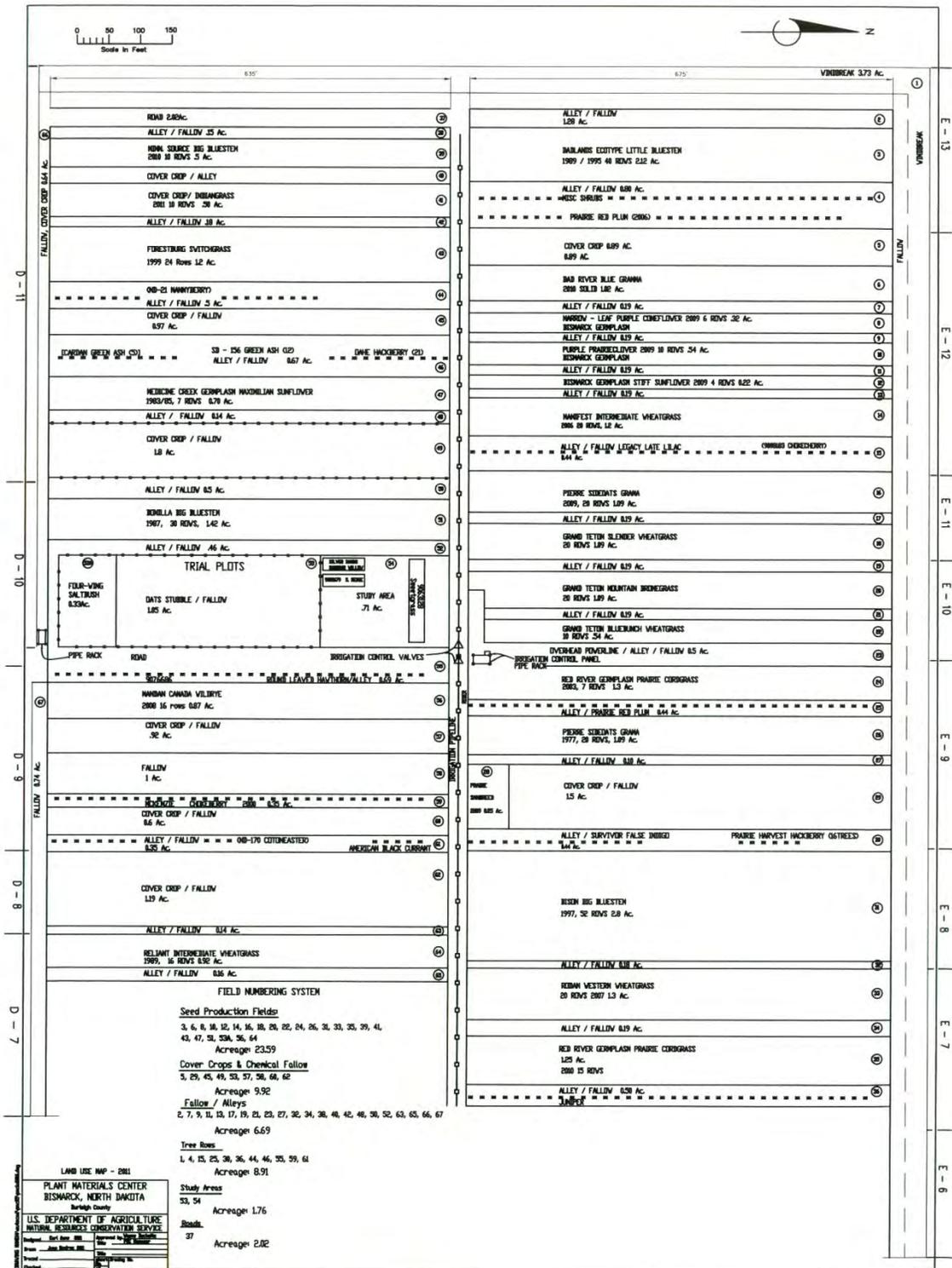
North Dakota and Minnesota are the two coldest States in the nation excluding Alaska. Mean annual temperatures range from 36 degrees F to 48 degrees F for all reporting stations. Plant hardiness zones (USDA) vary from 3 to 4 with mean minimum temperatures between -10 degrees F and -50 degrees F. Annual 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.

MAPS

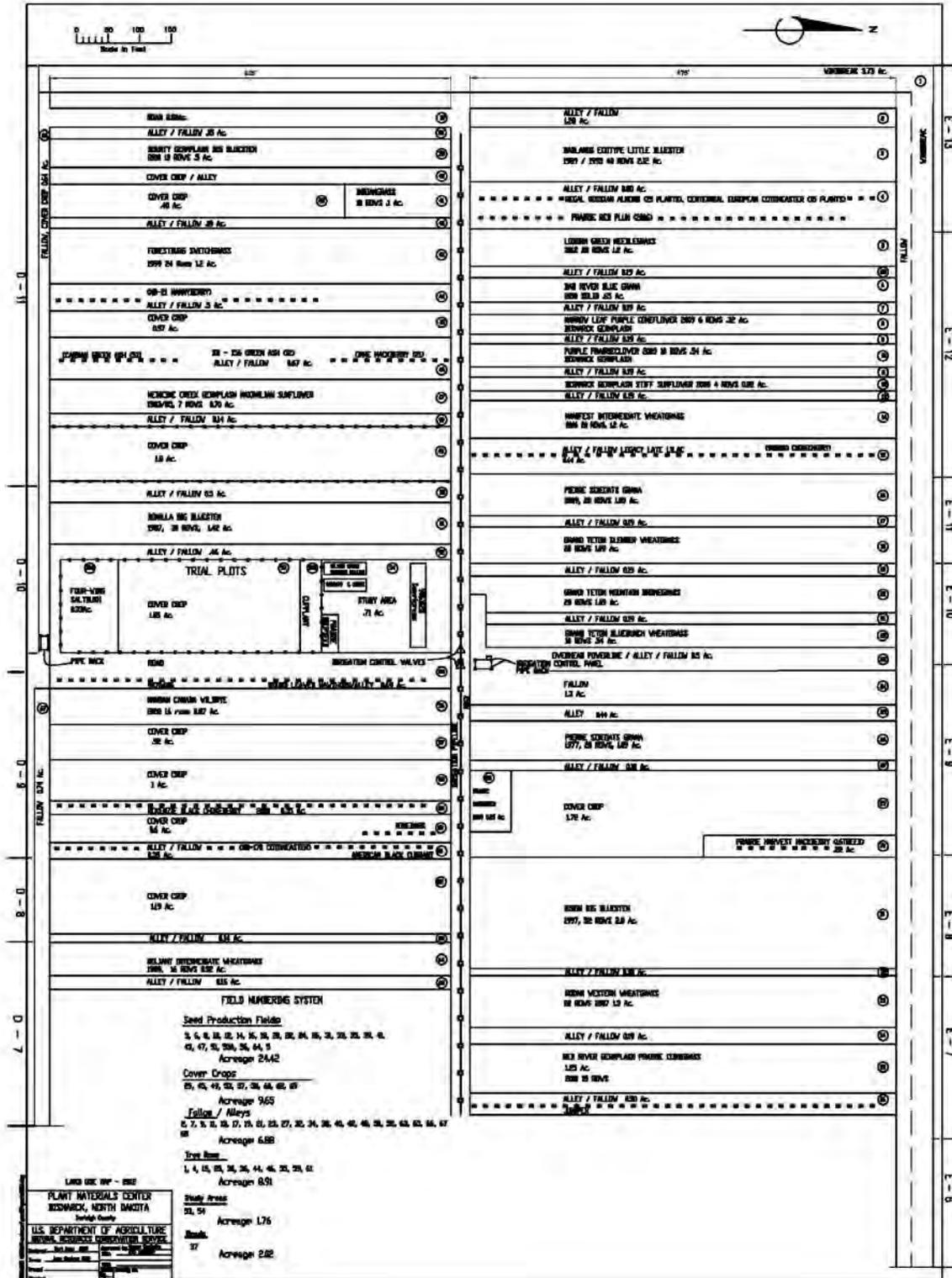


PLANT MATERIALS CENTER
 BISMARCK, NORTH DAKOTA
 CIRCLE 10
 U.S. DEPARTMENT OF AGRICULTURE
 SOIL CONSERVATION SERVICE
 CREDIT: BOB BISHOP
 BUREAU OF SOIL CONSERVATION

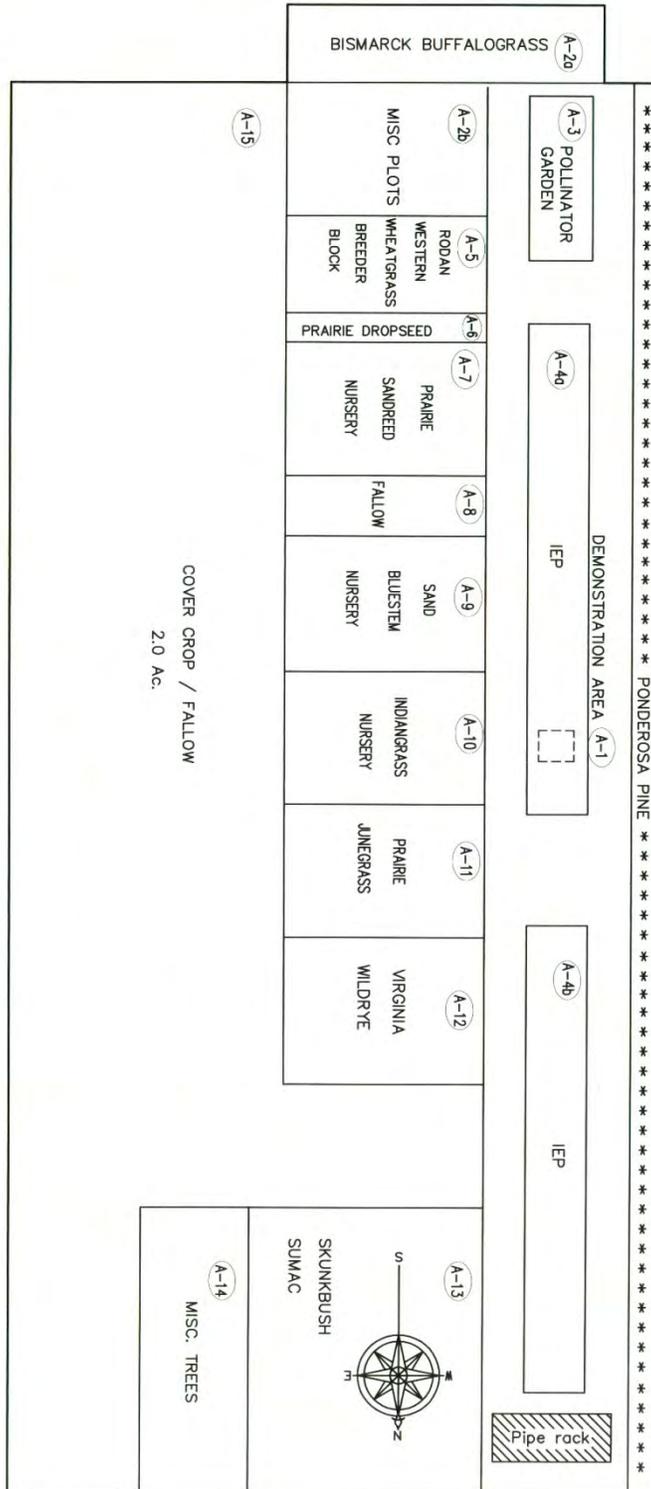
PMC Land Use Map - 2011

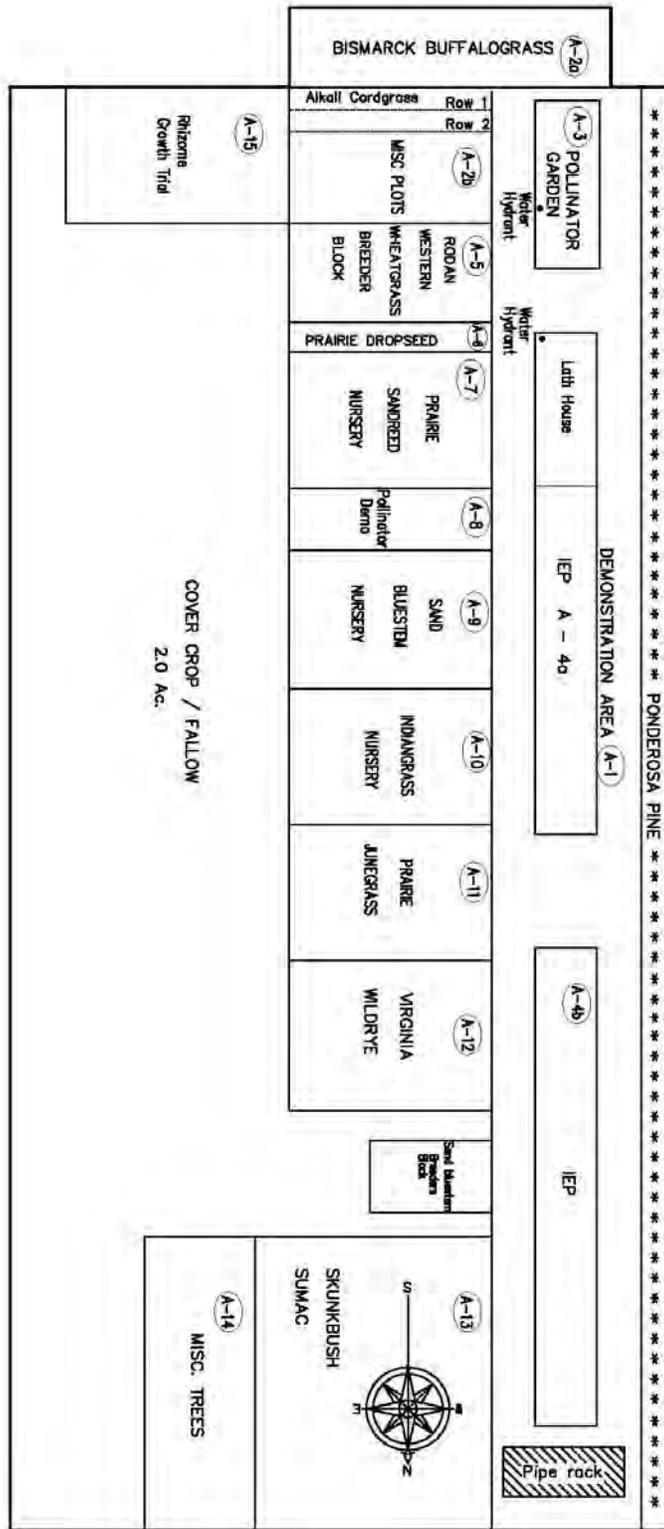


PMC Land Use Map - 2012



PMC Land Use Map, Panel A - 2011





ACTIVE STUDIES

OVERVIEW OF ACTIVE HERBACEOUS STUDIES AT THE BISMARCK PLANT MATERIALS CENTER – 2011-2012

Species	Use	Collection Information			Selections	Progress	2011/2012 Accomplishments
		Year	Material	Number			
prairie sandreed	erosion control on sandy sites	2003	seed	38	7 from MN	breeder plot established in 2009	seed harvest in 2011 & 2012, comparison planting with Koch
sand bluestem	sandy range, landscape	2003 2004	seed	21	10 preselected from MN, SD, ND	breeder population selected	reselection based on flowering date and plant characteristics
Indiangrass	prairie seedings, wildlife, landscape	2005	vegetative	41	25 from MN	breeder plot established	removal of early flowering plants, seed harvest 2012
prairie dropseed	prairie seedings, wildlife, landscape	1998-2005	seed	3	3 (large seed)	breeder plot established	seed harvest 2011 & 2012
prairie junegrass	prairie seedings, early forage	2006 2007	seed	97	TBD	selection	harvested seed from living plants (many died)
Virginia wildrye	wildlife, tree rows, prairie seeding	2008 2009	seed seed	34 47	TBD	breeder population selected	seed harvest 2011 and 2012
fourwing saltbush	range	1999	seed	1	1	seed increase	seed increase
cupplant	biomass, nutrient management, riparian	2011-2012	seed	1	TBD	evaluation field planted	greenhouse propagation, evaluation field established
white sage	cultural outreach	ongoing	vegetative	5	none	propagation bed established	distribution 2011: 370 distribution 2012: 108
sweetgrass	cultural outreach	ongoing	vegetative	1	none	propagation bed established	distribution 2011: 450 distribution 2012: 145
big sage	sage-grouse habitat	2009	seed	1	unknown	seed collection	propagation (greenhouse), field demo, carryover plants
big bluestem (Bounty Germplasm)	prairie restoration forage production conservation plantings	1985	vegetative	396	94 plants –Co. in MN 7 Co. in SD	breeder and foundation Field established	2011: seed harvest 2012: release, seed harvest

Species	Use	Collection Information			Selections	Progress	2011/2012 Accomplishments
		Year	Material	Number			
cover crop	soil health	2012	X	X	X	field establishment, data collection	field planted, soils sampled, forage clipped, laboratory analysis
quack X bluebunch	plantings in saline	2012	NewyHy ACSaltlander quack ,brome	X	X	test plot established	greenhouse propagation, field trial planted, data collection
IEP	initial evaluation of species and varieties	X	vegetative seed	variable	X	plants established	2011: Indiangrass, big bluestem planted 2012: data collection for various entries
National Parks	park revegetation	X	X	X	3 parks-Badlands of SD, Theodore Roosevelt, Grand Teton	fields established	see park reports
pollinator garden	pollinator habitat	X	X	X	X	establishment of demonstration site	additional species propagated and planted
Peoples Garden		X	X	X	X	squash production tomato production	2012: 850# Abraham Lincoln Tomatoes distributed to food banks

ACTIVE STUDIES: TECHNICAL REPORT 2011-2012

Study NDPMC-P-0104-RA

Study Title: Native Grasses for Conservation
Prairie dropseed *Sporobolus heterolepis*

Introduction: Prairie dropseed is a warm-season native that grows in circular tufts. It has been described as quite palatable to livestock, decreasing with grazing pressure. It is desirable to wildlife; birds and rodents eat its large seed and small wildlife can use the plant for cover. It has been identified as a desirable species in landscaping. Native Americans made a poultice from the roots to apply to sores and a decoction of root was taken to remove bile. Although seed is being sold for landscaping, and some local collections are being grown, a northern hardy release of this species for conservation use is not known. Such a release would provide a consistent and larger supply of this species for planting in the Northern Great Plains.

Objective: The purpose of this study is to evaluate adaptability and growth habit of prairie dropseed. If the collections produce seed and prove adaptable and useful as a conservation species, a public release of northern hardy material will be the goal.

Cooperators: USDA, NRCS Plant Materials Center, Bismarck, North Dakota

Description: Prairie dropseed is a warm-season perennial that grows in circular tufts. Plants appear to form colonies in the wild. The seed head is an open pyramid-shaped panicle. There are usually only a few seeds produced per plant. When in flower, these plants produce a vanilla-like odor. The seeds are small, round, shiny and hard, and drop when mature in August and September. There are approximately 1,200,000 seeds per pound. The leaves are narrow and 8-20 inches long and are mostly basal and hairless and radiate from the center of the tuft.

Distribution: Prairie dropseed is usually found growing on lighter textured soils of moist, mixed grass prairie communities. In the tall grass prairies, it often flowers only when stimulated by mowing or burning. It prefers sites where there is little competition from other grasses.



The study consists of two parts. The first is the assembly and evaluation of three collections of prairie dropseed for potential release development. This part of the study will be named **Field Plot** in this report. The second part of the study is evaluation of germination of prairie dropseed as it relates to seed size and age. This will be named **Germination Trial**.

Field Plot - Methods and Materials

Collection: One collection site each was harvested from Minnesota, North Dakota, and South Dakota. Seed collection information is found in Table PD-1. Seed was collected by PMC personnel. Less than 50 grams of seed were collected for each accession.

Assembly: Seed was cleaned using a rub board, pan screens, and South Dakota seedblower prior to planting in the greenhouse. Seed was planted to cone-tainers™ in the greenhouse and the seedlings for each accession were planted in June to separate single field rows in Panel A at the PMC. Space between plants is 1-2 feet. Rows are spaced approximately 5 feet apart. Each accession was planted in a different year. Accession 9082623 (ND) was planted in 2000 and the row extended in 2002. Accession 9082741 (MN) was planted in 2002 and accession 9092028 (SD) was planted in 2006. Each row has 30-50 plants.

Maintenance: Rows have been hand weeded and shallow tilled. No herbicides or fertilizer have been applied. Vegetative residue has been removed by hand clipping in late fall or early spring. In 2005, the residue was burned early in April. Residue was also burned in the late fall of 2006. Residue was hand clipped in early spring of 2008 and 2009. Residue from 2009 was clipped in October 2009.

Evaluation: Visual observations of plant growth have been recorded. In 2007, the number of seed culms, culm height, and leaf length were recorded for all accessions. See Table PD-2. Seed has also been hand harvested and cleaned each year. See Table PD-3 for harvest amounts.

Field Plot - Results and Discussion

Germination in the greenhouse was fair for all accessions. Growth of the seedlings in the greenhouse and the first year in the field was slow. Plant height in the field for the North Dakota accession was about 6 inches at the end of the first year. The North Dakota and Minnesota accessions produced a few seed culms the first year. The South Dakota accession had a very poor start. Seed was planted later than usual in the greenhouse due to greenhouse heating problems. Plants of this accession were very small when transplanted to the field. The plants remained very small the first year due to extreme heat and drought stress. Field survival was 80% or greater for all accessions.

Flowering date has not been recorded, but the three accessions appear to flower at similar dates. Flowering was noted about 8/13/2002 for the North Dakota accession. Flowering dates need further observation.

Spring burning of residue in 2005 appeared to stimulate seed culm production in the North Dakota and Minnesota accessions. Seed culm production in 2008 was less than previous years for the North Dakota and Minnesota collections. Seed culm production was fair in 2009 for all accessions. The Minnesota accession had slightly less production in 2009 compared to the North Dakota accession. Seed production in 2010 was similar to that of 2009. Seed production was the greatest for the South Dakota accession, and poor for the Minnesota accession. The South Dakota accession produced more seed culms than in previous years.

Plants of the South Dakota accession were more upright and crowns were less dense compared to North Dakota or Minnesota accessions. Buildup of residue at the crown of prairie dropseed appears to reduce seed culm production as plants age. Clipping removes some residue, but burning removes it more completely. The size, height, and seed culm numbers vary within an accession, but the variations are not great. Plant height is fairly uniform among the North Dakota and Minnesota accessions. The North Dakota accession is slightly shorter and more compact than the Minnesota or South Dakota accessions. The South Dakota accession was the most upright and tallest of the three accessions in 2009 and 2010. There were more leaves and forage for the North Dakota and Minnesota accessions. Disease and insects have not been a problem for any accession. Some plants of the North Dakota and Minnesota accessions showed slight crown die-off. No seed was harvested in 2011 or 2012 from the parent plants. Plans are to destroy the three row assembly in 2013.

Germination Trial – Methods and Materials

2008: The seed used for this trial was material that had been harvested from the field rows at the PMC. Lots used were SCO-07-9082623 (ND), SCO-07-9082741(MN), and SCO-07-9092028 (SD). Seed was cleaned using an office size fanning mill. Once clean, seed was separated by weight using a South Dakota seedblower, the smallest tube. Approximately ¼ teaspoon of seed was placed in the tube and blown for one minute. Air was opened to 3 cm. Seed remaining on the bottom of the tube after blowing was designated heavy seed. Seed that blew to the top of the column was then separated by setting the column opening at 2 cm. This was designated as medium weight. Light seed was discarded.

2008 Experimental Design: Four boxes (100 seed each) were used for each treatment. Heavy seed and medium weight seed were compared. Seed storage was also compared by testing seed that was stored in a seed cooler and seed that was stored outside the cooler after one year. The cooler conditions were approximately 40 degrees F and 40 percent or less humidity. The exact conditions in the cooler were not recorded. Seed stored at room temperature experienced the fluctuations of temperature and humidity. Exact temperatures and humidity were not recorded. Seed was tested just after harvest, at six months and after one year in one of the storage conditions listed above.

Germinator settings: Light and 30 degrees C for 8 hours, alternated with darkness and 20 degrees C for 16 hours. The duration of each test was 14, 21, and 28 days. Some differences in the number of days between counting occurred as a result of scheduling conflicts. Seedlings were counted at 33 days rather than 28 days in April and October 2008.

2008 Germination Trial - Results and Discussion

See Table PD-4 for the average germination percentages of each treatment after 28-33 days. These are averages of the four replications of each treatment. Germination counts at 7, 14, and 28 days were recorded, but are not listed in the table. They are available from the Plant Materials Center. Mold became a severe problem in the plastic germination boxes, particularly for the October 2008 counts. Seed was considered germinated if it had a root and shoot. Roots were sometimes a challenge to distinguish. It appears that seed stored in the cooler after one year generally had higher germination than the newly harvested seed or 6 month old seed. When stored at room temperature, the germination was slightly less than the newly harvested seed in most cases. The slight increase in germination after 6 months compared to freshly harvested seed indicates that there is probably dormancy that breaks down after 6 months, and after one year, if stored in a controlled climate. Size of seed showed slight differences in germination, but not as much as anticipated. The larger seed generally showed greater germination. Seed lots also were quite different in their germination, particularly the South Dakota accession. These were very young plants, compared to the Minnesota and North Dakota accessions. This may have contributed to the low overall germination.

Preliminary indications do suggest that large seed, stored in cold storage will provide the greatest germination.

Population Selection/Breeder Field

Large seed was considered the criteria for developing a breeder population. Large seed was selected from prior harvests for each of the three accessions. Seed harvest years included 2001-2009 for accession 9082623 (ND); 2003-2009 for accession 9082741 (MN); and 2008-2009 for accession 9092028 (SD). Four random samples of 1 tablespoon each were taken from each lot. Each tablespoon of seed was blown in the 3 inch tube of the South Dakota Seedblower. Each sample was blown for 1 minute with the top air open to 10. The seed remaining in the bottom from each of the 4 samples from each lot was then mixed together. This was considered the heaviest seed. Less than 50 seeds of some lots were heavy enough to stay in the bottom of the air tube, so more than 4 samples had to be taken from those seed lots. From each mix (lot) 50 seeds were planted on 3/5/10 in the greenhouse (25 seeds/small box type flat). The plants growing from the seed that germinated were planted to individual 3 inch pots on 5/6/2010. Seedlings were counted on 4/15/10 in the greenhouse. Not all seed that germinated survived in the greenhouse. The 226 surviving seedlings were planted on 6/23/2010 to field D10 in a plot north of the old deer fence. Nine rows were planted. Each row was spaced 42 inches apart and plants were spaced approximately 2 feet apart. The plants of each accession were intermixed within the rows and were planted in a completely random order. Listed below are the plants that were included in the breeder population crossing block in 2010.

HV Year	North Dakota 9082623	Minnesota 9082741	South Dakota 9092028
2001	0	x	x
2002	0	x	x
2003	4	6	x
2004	7	11	x
2005	1	0	x
2006	6	2	x
2007	15	8	x
2008	31	22	8
2009	44	30	32

No seedlings were grown from the lighter seed. Generally, the younger seed germinated and produced more seedlings than the older seed. All seed had been stored in cold, dry storage.

On October 14, 2010 seed was hand stripped from the breeder block north of the old deer fence. Some of it was slightly green. As 2010 was the year of transplanting, the growth stages were likely affected for the year. After cleaning with pan screens and the South Dakota seedblower, 58 grams of seed remained. In 2011, the field plot was maintained by hand roguing. The residue from 2011 was burned in early spring of 2012. Seed was hand harvested from the selected population (breeder block) in 2011. The bulk seed amount after cleaning was 1062 grams. The field plot was hand rogued and shallow tilled in 2012 to reduce weeds. Thistles were spot sprayed with roundup. A small plot combine (Wintersteiger) was used in 2012 to harvest seed. The bulk seed amount after cleaning was 5 pounds.

Plants show variability in size and seed production in the breeder block. All plants produced some seed in 2012. Plants are vigorous and are growing in crown size (width) each year.

Table PD-1. Collections - prairie dropseed *Sporobolus heterolepis*

Date	Accession	County	State	Location
10/1998; 9/8/1999 8/18/2000; 8/29/2001	9082623	Burleigh	ND	Russell Stuart Wildlife Management Area SE1/4 sec. 3-T144N-R78W
10/19/2001	9082741	Mahnomen	MN	Wambuck WMA - 5 1/2 mi. north of Mahnomen and 1 1/2 mi. east
9/27/2005	9092028	Day	SD	Pickerel Lake entrance (448th Ave.) sec. 23-T124N-R53W -large flat

Table PD-2. Plant evaluations - prairie dropseed *Sporobolus heterolepis*

Data collectors: Jensen, Duckwitz
 Seed culm rating: 1=many culms 3=none or very few culms
 Culm height: average height of culms
 Leaf length: length of leaf measured from center of crown

Planting Date	Date of Data	Accession	Plant	seed culm rating (1-3)	culm height (inches)	leaf length (inches)	Comments
2000	10/3/2007	9082623	1	1	33	18	
2000	10/3/2007	9082623	2	1	27	19	
2000	10/3/2007	9082623	3	3	29	13	
2000	10/3/2007	9082623	4	2	20	12	
2000	10/3/2007	9082623	5	1	35	17	
2000	10/3/2007	9082623	6	1	28	17	
2000	10/3/2007	9082623	7	1	34	17	
2000	10/3/2007	9082623	8	1	28	19	
2000	10/3/2007	9082623	9	1	24	15	
2000	10/3/2007	9082623	10	1	26	19	
2000	10/3/2007	9082623	11	2	36	20	
2000	10/3/2007	9082623	12	2	26	16	
2000	10/3/2007	9082623	13	1	36	16	
2000	10/3/2007	9082623	14	2	26	12	
2000	10/3/2007	9082623	15	1	34	13	
2000	10/3/2007	9082623	16	1	38	21	
2000	10/3/2007	9082623	17	2	33	16	
2000	10/3/2007	9082623	18	1	30	16	
2000	10/3/2007	9082623	19	2	32	22	
2000	10/3/2007	9082623	20	1	33	16	
2000	10/3/2007	9082623	21	1	34	20	
2000	10/3/2007	9082623	22	1	42	20	
2000	10/3/2007	9082623	23	1	31	15	
2000	10/3/2007	9082623	24	1	34	19	
2000	10/3/2007	9082623	25	3	27	10	
2000	10/3/2007	9082623	26	1	40	20	many heads
2000	10/3/2007	9082623	27	1	32	14	
2000	10/3/2007	9082623	28	2	28	17	
2000	10/3/2007	9082623	29	2	25	18	
2000	10/3/2007	9082623	30	1	32	16	red stems
2000	10/3/2007	9082623	31	3	0	11	no heads
2000	10/3/2007	9082623	32	1	20	10	
2000	10/3/2007	9082623	33	1	28	13	
2000	10/3/2007	9082623	34	2	31	18	
2000	10/3/2007	9082623	35	1	34	16	
2000	10/3/2007	9082623	36	1	36	19	
2000	10/3/2007	9082623	37	1	36	21	yellow stems
2000	10/3/2007	9082623	38	3	0	19	
2000	10/3/2007	9082623	39	2	29	13	

Planting Date	Date of Data	Accession	Plant	seed culm rating (1-3)	culm height (inches)	leaf length (inches)	Comments
2000	10/3/2007	9082623	40	2	27	13	
2000	10/3/2007	9082623	41	3	0	11	
2000	10/3/2007	9082623	42	1	32	19	
2000	10/3/2007	9082623	43	2	24	14	
2000	10/3/2007	9082623	44	3	21	13	aborted heads
2000	10/3/2007	9082623	45	2	24	15	
2000	10/3/2007	9082623	46	2	16	15	
2000	10/3/2007	9082623	47	2	30	15	
2000	10/3/2007	9082623	48	1	25	13	
2000	10/3/2007	9082623	49	3	24	17	few heads
2002	10/3/2007	9082623	50	1	30	14	
2002	10/3/2007	9082741	1	1	32	26	
2002	10/3/2007	9082741	2	3	28	23	
2002	10/3/2007	9082741	3	2	36	22	
2002	10/3/2007	9082741	4	1	46	22	
2002	10/3/2007	9082741	5	1	27	8	
2002	10/3/2007	9082741	6	2	23	13	
2002	10/3/2007	9082741	7	2	17	16	
2002	10/3/2007	9082741	8	1	36	18	
2002	10/3/2007	9082741	9	1	36	20	
2002	10/3/2007	9082741	10	1	46	21	
2002	10/3/2007	9082741	11	3	27	22	
2002	10/3/2007	9082741	12	2	31	20	
2002	10/3/2007	9082741	13	1	38	19	
2002	10/3/2007	9082741	14	1	36	20	
2002	10/3/2007	9082741	15	1	29	19	
2002	10/3/2007	9082741	16	3	15	21	
2002	10/3/2007	9082741	17	1	38	21	
2002	10/3/2007	9082741	18	2	17	22	
2002	10/3/2007	9082741	19	2	13	9	
2002	10/3/2007	9082741	20	2	32	21	
2002	10/3/2007	9082741	21	3	12	24	
2002	10/3/2007	9082741	22	1	36	19	
2002	10/3/2007	9082741	23	1	24	20	
2002	10/3/2007	9082741	24	1	34	19	
2002	10/3/2007	9082741	25	3	8	23	no culms
2002	10/3/2007	9082741	26	3	8	23	no culms
2002	10/3/2007	9082741	27	1	46	21	
2002	10/3/2007	9082741	28	2	35	18	
2002	10/3/2007	9082741	29	1	36	20	
2002	10/3/2007	9082741	30	1	38	20	
2002	10/3/2007	9082741	31	1	34	17	
2002	10/3/2007	9082741	32	2	28	8	
2002	10/3/2007	9082741	33	2	28	10	
2002	10/3/2007	9082741	34	1	34	18	

Planting Date	Date of Data	Accession	Plant	seed culm rating (1-3)	culm height (inches)	leaf length (inches)	Comments
2002	10/3/2007	9082741	35	2	29	15	
2006	10/3/2007	9092028	1	1	28	8	
2006	10/3/2007	9092028	2	3	14	10	two heads
2006	10/3/2007	9092028	3	2	30	8	
2006	10/3/2007	9092028	4	3	0	1	very small
2006	10/3/2007	9092028	5	3	0	11	no heads
2006	10/3/2007	9092028	6	2	18	8	
2006	10/3/2007	9092028	7	1	25	12	
2006	10/3/2007	9092028	8	1	15	6	
2006	10/3/2007	9092028	9	2	19	8	
2006	10/3/2007	9092028	10	3	0	8	
2006	10/3/2007	9092028	11	1	24	11	
2006	10/3/2007	9092028	12	2	23	9	
2006	10/3/2007	9092028	13	3	14	7	one head
2006	10/3/2007	9092028	14	3	16	6	two heads
2006	10/3/2007	9092028	15	1	19	7	
2006	10/3/2007	9092028	16	3	0	5	
2006	10/3/2007	9092028	17	2	23	9	
2006	10/3/2007	9092028	18	3	0	8	
2006	10/3/2007	9092028	19	1	24	7	
2006	10/3/2007	9092028	20	1	33	11	
2006	10/3/2007	9092028	21	3	12	5	two heads
2006	10/3/2007	9092028	22	1	38	13	
2006	10/3/2007	9092028	23	3	0	5	
2006	10/3/2007	9092028	24	2	14	9	
2006	10/3/2007	9092028	25	1	36	10	
2006	10/3/2007	9092028	26	3	0	4	stressed
2006	10/3/2007	9092028	27	3	0	4	
2006	10/3/2007	9092028	28	3	0	2	very small
2006	10/3/2007	9092028	29	3	22	8	two heads
2006	10/3/2007	9092028	30	3	0	5	
2006	10/3/2007	9092028	31	3	16	6	two heads
2006	10/3/2007	9092028	32	3	0	5	
2006	10/3/2007	9092028	33	3	0	7	
2006	10/3/2007	9092028	34	3	26	8	two heads
2006	10/3/2007	9092028	35	3	0	6	
2006	10/3/2007	9092028	36	2	26	12	
2006	10/3/2007	9092028	37	1	32	12	
2006	10/3/2007	9092028	38	2	26	12	
2006	10/3/2007	9092028	39	3	0	4	
2006	10/3/2007	9092028	40	3	3	3	very small

Table PD-3. Seed harvest (Panel A) - prairie dropseed *Sporobolus heterolepis*

Accession*	State	Year	Date	Dirty	Clean bulk Yield (gm)		Cleaning Procedure**
9082623	ND	2001	09/10/01		45		
9082623	ND	2002	09/10/02		191		
9082623	ND	2003	09/22/03		211		
9082623	ND	2004	09/30/04		497		
9082623	ND	2005	09/21/05		1033		
9082623	ND	2006	09/28/06		245		
9082623	ND	2007	10/02/07	584	390		9 hole and blank, 1/4-1/2 air open, office mill, no debearder
9082623	ND	2008	09/29/08	518	344		
9082623	ND	2009	10/2009		284		
9082623	ND	2010	10/2010		477		
9082741	MN	2002	09/01/02		1.4	5 plants	
9082741	MN	2003	09/22/03		119		
9082741	MN	2004	10/01/04		357		
9082741	MN	2005	09/21/05		782		
9082741	MN	2006	09/28/06		250		
9082741	MN	2007	10/02/07	493	368		9 hole and blank, 1/4-1/2 air open, office mill, no debearder
9082741	MN	2008	09/29/08	331	195		
9082741	MN	2009	10/2009		206		
9082741	MN	2010	10/2010		165		
9092028	SD	2007	10/02/07	53	38		9 hole and blank, 1/4-1/2 air open, office mill, no debearder
9092028	SD	2008	09/29/08	592	359		
9092028	SD	2009	10/2009		560		
9092028	SD	2010	10/2010		688		

*Date plants were planted from the greenhouse to the field: June 2000 - 9082623 (ND); June 2002 - 9082741 (MN); June/July 2006 - 9092028 (SD)

**All seed was collected by hand stripping and cleaned using office debearder and office mill (unless noted)

Table PD-4. Average percent germination - prairie dropseed *Sporobolus heterolepis* germination study

	New Harvest* Oct-07	Six Months** Apr-08	One Year** Oct-08	
			room temp	cold storage
ND heavy	55	69	55	80
MN heavy	59	68	48	73
SD heavy	44	61	19	61
ND medium	58	60	47	75
MN medium	49	53	43	58
SD medium	30	33	3	32

*Average percent germination after approximately 28 days

**33 days for April 08 and October 08

Residue management: Residue was hand clipped (2005-2007) or mowed with a sickle mower (2008) to a 3-4 inch stubble height in early spring of each year. Residue was removed by hand raking. Residue was removed by swathing and raking in November of 2009. Burning the residue of standing plants was attempted in November 2006. Most of the residue resisted burning and had to be hand clipped. The plot was mowed 2-3 times in 2010, 2011, and 2012 to keep weeds under control and to prevent any seed from forming and dispersing.

Evaluations:

No data was collected in 2004; the year seedlings were transplanted to the field plot. Data was collected for each plant in the field plot from 2005-2008. See 2009 Technical Report for all plant data. An initial breeder population was selected in 2008 based on collected data. Forage quality was analyzed for the initially selected plants along with others from the field plot. Stalk strength was rated in April 2008 as an indicator for use in biomass projects. Plant data was reevaluated in late 2008 and early 2009. A decision was made to select plants only with Minnesota origins. Data for the final selections of the breeder population is found in Table PS-2.

Forage Analysis Sampling: Forage was sampled on 7/22/2008. Several stems were clipped from the middle of the plant. Twenty stems from each of the selected plants were used. The leaves were clipped from the top five nodes of each of the 20 stems. Stems were discarded. Leaves were oven dried at approximately 30 degrees C for 2-3 days. NIRS analysis was run by Oscar Olson Biochemistry Laboratories at South Dakota State University, Brookings. See Table PS-3 for analysis results and stalk strength ratings of selected breeder population plants.

Breeder Population (MN Selections):

Selections made in 2008 for the breeder population were changed in 2009 to include only Minnesota accessions. A map of 2009 selections is found in Figure PS-2. Selections were rated superior in 2007 for disease resistance. Secondary selection was based on leafiness and overall growth. Most had been selected in 2008, with only a few exceptions. Portions of the selected plants (2009 selections) were dug on April 21, 2009 and April 23, 2009. The pieces were then planted into large black cone-tainers™ in the greenhouse in a potting soil mix. The pieces were generally large, as prairie sandreed has a coarse, tough rhizome that usually has a sharp shoot. Fifty rhizome/root pieces were planted for each of the selections. The plants were very slow to grow in the greenhouse from the root and rhizome pieces. On June 23, 2009, they were planted to a crossing block in Panel E-9. The plants were spaced approximately 1-2 feet apart. Trenches were made with shanks and the plants were planted into these. The trenches were spaced approximately 42 inches apart. The plants were planted in a completely randomized fashion, in relation to accession. This was to try and get a more random pollination (crossing). Many of the plants did not have well developed roots. The planted root pieces were not decayed, were still imbibing water, and had some top growth. Irrigation was started the day of planting using overhead irrigation lines. Ten rows, approximately 40 feet long, were planted.

2010: The breeder population crossing block (E-9) was increased in size in 2010. Additional roots and rhizomes from the selected plants in the initial evaluation block were dug and propagated in the greenhouse. A total of 296 plants were added to the crossing block on 6/23/2010. Approximately 30-50 plants from each of the seven selected parent plants were planted in E-9 in 2010. The field was hand rogued and spot sprayed for weeds.

2011: No selection and no additional plants were added to the population. Plot was maintained. Seed was harvested.

2012: Seed was harvested from the Breeder population using a small plot combine. A plot comparing the Bismarck PMC material (9094357) and the release, 'Koch' from the Michigan PMC were seeded into a black, firm seedbed on May 17, 2012, using a plot drill. Each plot was 5.5 feet x 80 feet. The planting was located in panel D-10 (old deer fence). Koch was the northernmost plot. Dry conditions and excessive weeds prevented adequate establishment. Plans are to reestablish the comparison plots in 2013.

Results and Discussion

Plants within an accession did not always perform in a similar manner in the initial evaluation block. This was expected as plants were propagated from seed, making genetics different. Due to these differences, each plant was evaluated individually.

Overall, plants were very slow to establish in greenhouse and field plantings.

Plants were very slow to establish and mortality was high in 2004. Plants that survived and grew in 2005 were vigorous and began spreading by rhizomes. Plants varied in their ability to spread. There was variation in leaf width and coarseness of the plant as well. In 2005, foliar and leaf diseases manifested in certain plants. Disease was not as

noticeable in 2006 compared to 2005, but some plants did exhibit severe infestations by the end of the growing season. The dry climatic conditions of 2006 were likely contributing factors. Rhizome growth and vegetative growth were strong for both years. Disease in 2005 was noted, with some accessions severely affected with stem and leaf diseases.

2007: Plants were vigorous. The differences in size and color of plants were quite noticeable. Plant disease was prominent for some accessions, causing the plants to lodge and leaves and stems to blacken. Some plants showed very little disease. Selections based on visual observations were noted.

2008: Selections for the breeder population were based on various parameters. Date of flowering, disease, and overall plant size and form were the main criteria on selection. The population selected has flowering dates that were similar. This is necessary for seed production. The plants selected also exhibited less leaf and stem rust compared to other plants. Selected plants were generally leafy, upright, and somewhat dense in stem production.

2009: The breeder population was re-selected to include only Minnesota origin accessions. Plant growth above ground was slow throughout the summer of 2009, but mortality was low. The plant height at freeze-up was 2 feet or less. Very few plants produced a seed head in 2009.

Seed harvests (amount after cleaning) from the breeder crossing block (E-9) were as follows: 2010 = 85 grams, 2011 = 1.2 pounds, 2012 = 2.5 pounds. Plants continued to grow larger and produce more seed heads each year.

Figure PS-1. Plot layout - prairie sandreed *Calamovilfa longifolia*.

Location: Panel A

Planted: 7/6/2004

West



Rep 1			Rep 2			Rep 3				
Row 1	Row 2	Row 3	Row 4	Row 5	Row 6	Row 7	Row 8	Row 9	Row 10	Row 11
ND95	2817	2818	Goshen	ND95	2789	2784	Goshen	2818	p2 2788	2820
p2 2820	2778	p3 2815	2816	2825	2813	2826	2773	2817	2783	ND95
2825	2776	2813	2782	2783	p2 2818	2774	2774	p2 2814	2784	2816(2)
2780	2771	2793	2823	2792	2775	2776	2771	2815	2781	2787(1)
2783	2774	2789	2822	p3 2814	2773	2817	2772	2813	2780	2786(2)
2788	2773	2784	2779(2)	2778	2772	2794	2775	2794	2825	2823(2)
2792	2772	2781	2790	2771	2777	2788	2776	2792	2826	2822(3)
2794	2775	2826	2787	2821	p1 2815	2780	2778	2793	2821	2786(1)
2814	2777	2821	2786	2781	2793	2820	2777	2789	Goshen	2790(1)
										2816(2)
										2787(1)

Final selections(2009) p = plant number (from west)

Seedlings were grown in the greenhouse. Seedlings were in very poor condition when field planted.

Row spacing: 3 1/2 feet between plants and 3 1/2 feet between rows

The prefix for each accession is 908.

Accessions are in 3 plant plots unless designated in ().

Figure PS-2. Minnesota map showing county origins of the selected prairie sandreed *Calamovilfa longifolia* accessions.

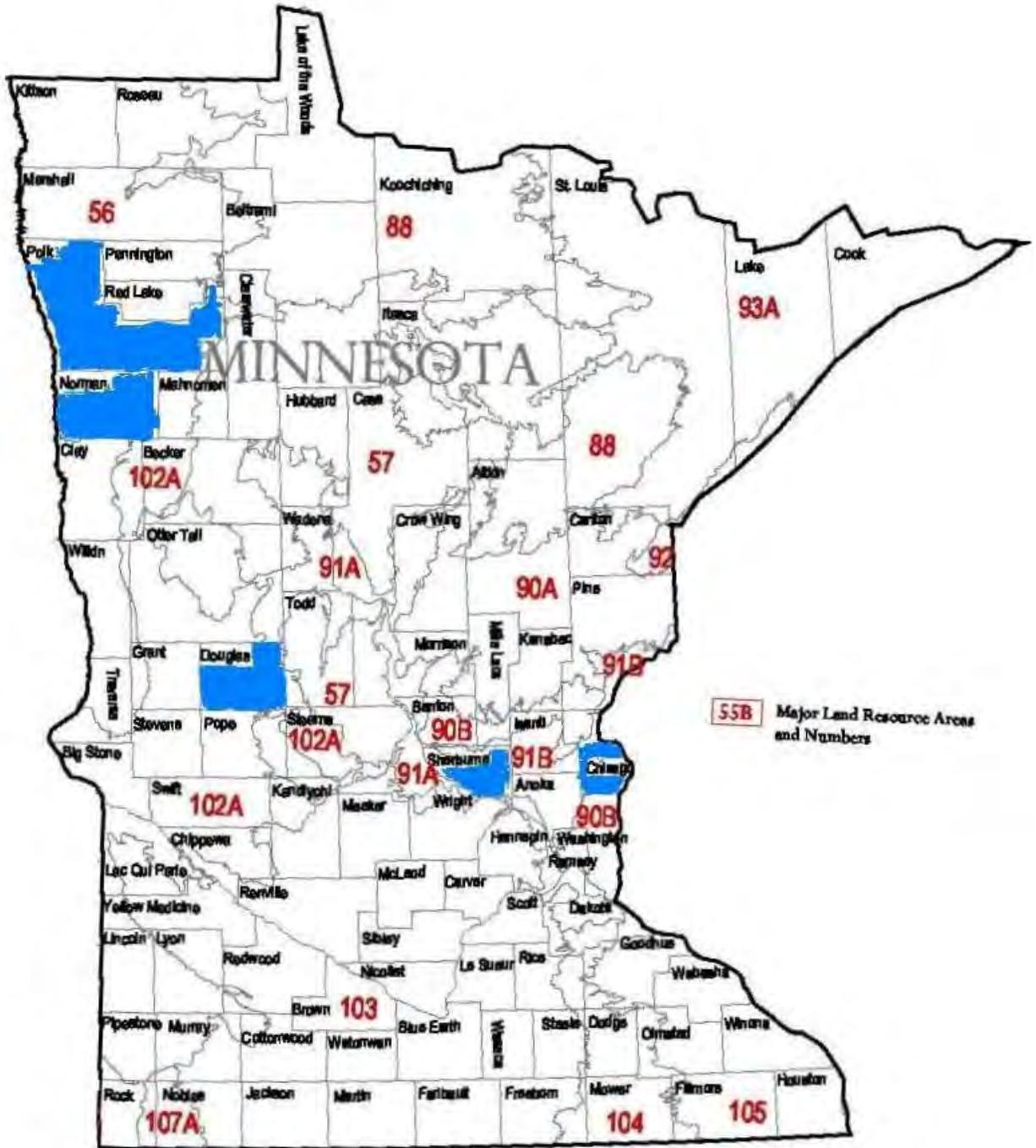


Table PS-2. Evaluation data 2005, 2006, and 2007 of Breeder Population - Prairie sandreed *Calamovilfa longifolia*.

Key: **1-3 rating scale**

Leaf width: 1=narrow, fine 3=wide, coarse
 Leafiness: 1=many leaves 3=few leaves
 Disease: 1=lack of disease 3=severe
 Seed culms: 1=many 3=few or none
 Lodging: 1=none 3=severe
 Size: 1=large, robust 3=small

1-9 rating scale

Leafiness: 1=many leaves 9=few leaves
 Disease: 1=lack of disease 9=severe
 Vigor: 1=excellent vigor 9=poor vigor

EW=east-west spread (inches)
 NS=north-south spread (inches)

*Accn=accession (908 prefix)

**sel=selected for conservation in 2007

***lsp sel=selected for landscaping in 2007

Date	908 Accn*	Row	Plant no.	(in.) Culm height	(in.) Veg. height	(in.) EW spread	(in.) NS spread	rating Leaf width	rating Leaf-iness	rating Di-sease	rating Seed culms	No. of culms	rating Vigor	rating Lodging	rating Size	** sel	*** lsp sel	Comments	
08/26/05	2788	10	2	34	18	7	8	2	3	2		3	3						
08/04/06	2788	10	2	69		24	27	3	2		1								short, wide
08/07/07	2788	10	2						1	1	1			2	1	x			
08/26/05	2814	5	3	73	13	5	9	3	2	2		17	3						
08/04/06	2814	5	3	77		29	23	1	2		1								fine leaves
08/07/07	2814	5	3						1	1	2			3	1				
08/26/05	2814	9	2	47	16	12	8	2	4	3		2	3						
08/04/06	2814	9	2	54		19	13	2	2		2								
08/07/07	2814	9	2						2	1	1			2	2	x			blue
08/26/05	2815	3	3	42	5	3	3	3	6	2		3	3						
08/04/06	2815	3	3	49		15	13	1	2		2								clean
08/07/07	2815	3	3						1	1	2			1	2				leafy, fine leaves
08/26/05	2815	6	1	0	20	9	3	3	5	4		0	3						
08/04/06	2815	6	1	45		15	13	2	1		3								blue, leafy
08/07/07	2815	6	1						1	1	2			1	2	x			
08/26/05	2818	6	2	46	9	10	7	2	4	5		8	4						
08/04/06	2818	6	2	52		23	17	2	2		1								leafy
08/07/07	2818	6	2						1	1	1			1	2	x			
08/26/05	2820	1	2	48	26	7	11	2	3	2		4	3						
08/04/06	2820	1	2	60		15	20	2	2		3								stressed, lodged
08/07/07	2820	1	2						2	1	3			2	2				

Table PS-3. Forage analysis, stalk strength, and phenology - Prairie sandreed *Calamovilfa longifolia*.

Test Date	908 Accn*	Row	Plant No.	Forage Quality Analysis**					Rating 4/3/2008	7/28/2008 Phenology	Origin	
				CP	ADF	NDF	RFV	RFQ	Stalk Strength***		State	County
8/7/2008	2788	10	2	13.6	40.7	75.1	71	89	3	late boot	MN	Sherburne
8/7/2008	2815	3	3	14.6	39.8	70.2	77	100	2	pre-anthesis	MN	Norman
8/7/2008	2820	1	2	13.7	35.5	65.6	87	129	--	late boot	MN	Chisago
8/7/2008	2814	9	2	16.1	35.5	68.6	83	127	--	--	MN	Polk
8/7/2008	2815	6	1	14.1	39.0	70.9	77	110	--	--	MN	Norman
8/7/2008	2818	6	2	15.9	38.1	71.5	77	102	--	--	MN	Douglas

plants selected for breeder population in 2009 (Accn # 2814 Row 5, Plant 3 was not clipped for forage analysis as it was selected after forage analysis)

* Accn=accession (908 prefix)

** Forage Quality: CP = crude protein, ADF = acid detergent fiber %, NDF = neutral detergent fiber %, RFV = relative feed value, RFQ = relative feed quality; forage was sampled 7/22/2008

*** Stalk strength: 1=upright, 3=lodged

Data for stalk strength and phenology were not recorded for all of the collections that had forage analysis. This was due to selection and 2 reselections before deciding a final selected population.

ACTIVE STUDIES: TECHNICAL REPORT 2011-2012

Study: NDPMC-P-0402-RA

Study Title: Sand Bluestem Seed Increase (*Andropogon hallii*)

Introduction: Plant species available for stabilizing sandy soils are limited. Sand bluestem is a tall, warm-season, perennial grass, native on sandy sites in the Great Plains. Its growth habit and forage quality are important attributes when used in conservation plantings.

Objective: The purpose of this study is to develop a sand bluestem release from native collections from Minnesota, North Dakota, and South Dakota. Superior plants will be selected and the release would be for various conservation plantings on sandy sites in Minnesota, North Dakota, and South Dakota.

Cooperators: USDA, NRCS, Bismarck Plant Materials Center, Bismarck, North Dakota

Description: Sand bluestem is a tall, perennial, warm season grass that can grow to a height of 7 feet. It has short rhizomes. The culms are solid. The seed heads are racemes forming the "turkey foot" shape and closely resembling big bluestem. It is distinguished from big bluestem by its lack of hairs on the leaves and the dense yellow hairs on the seed heads. The stems tend to be straw-colored. It is not as palatable as big bluestem but can provide excellent grazing. It decreases with grazing pressure.

Distribution: Sandy soils of the Great Plains

Methods and Materials

Collection: Seed was hand harvested from various sites throughout Minnesota, North Dakota, and South Dakota in the fall of 2004. Each collection was accessioned (assigned an identification number). See Table SB-1 for a list of collection information.

Assembly: Seed was planted to cone-tainers™ in the greenhouse in February of 2005. Seedlings were hardened off in the lath house and planted to a field in Panel A at the PMC in May 2005.

Planting Plan: See Figure SB-1 for a planting plan. The planting was made on 5/24/2005. Accessions were planted in three-plant plots, with accessions random within a replication. Three replications were planted. The third replication does not have all three plants for all accessions, due to limited germination of seed in the greenhouse. Plants were spaced 42 inches apart within the row and rows were 42 inches apart.

Site Preparation: The site was prepared by tilling and slightly packing prior to planting. The site was black fallowed at least 2 years before planting.

Planting Method: The plants were hand-planted. Holes were dug using special made dibble bars that produced holes approximately the length of the long roots growing in the cone-tainers™.

Planting Date: 5/24/2005

Maintenance: Initial Assembly

2005	Fertilizer - none
2005	Weed control - frequent shallow tilling using walk behind front tine garden tiller
2005	Irrigation - once right after planting to establish plants
2005	Residue removal - hand clipped to 3-inch stubble in November
2006	Fertilizer - none
2006	Weed control - shallow tilling, hand hoeing
2006	Irrigation - once in July during severe drought
2006	Residue removal - attempted to burn, hand clipped in November

2007	Weed control - shallow tilling, hand hoeing
2007	Fertilizer – none
2008	Residue removal – hand clipped in April
2008	Weed control, fertilizer – none
2009	Weed control – shallow tilling, hand-hoeing
2009	Residue removal – swathed and raked off in November
2010	Weed control-shallow tillage
2010	Residue removal- residue was left standing at the end of 2010
2011	Residue burned off in the spring, little or no other maintenance
2012	Little or no maintenance-plots were mowed off at the end of the growing season

Data Collection: Data was collected for each plant in the field from 2005-2008. See 2009 Technical Report for all data. Selections were based on flowering time, leafiness, and overall plant health. Plants were also identified as big bluestem or hybrid and are labeled “ANGE” in the table. These will not be included in the breeder population. A preselection of plants showing promise for the breeder population was made in 2008. See 2008 Technical Report. All plants of the evaluation block were visually re-evaluated in 2009. Plants with good seed culm production were selected and rated for seed fill. Plants were also evaluated for lodging. See 2009 Technical Report for ratings. Final selections for the breeder population were made in 2010. All data for 2010 selected breeder population is found in Table SB-2.

Breeder Population:

2011: Plants were propagated in 2011 from root and rhizome pieces. A breeder block was planted by cutting 10 pieces from each of the 10 selected plants in the original assembly. Plants were spaced 3.5 ft apart. The planting was a block of 10 plants and 10 rows. This was done May 6, 2011. Accessions were planted completely random in the breeder block, and no record was kept of where each accession was planted. The breeder block is located in Panel A just south of the skunkbush sumac assembly.

2012: Plants were reselected from the breeder population, based on flowering date, seed fill and overall performance. These will be propagated in 2013 and a new breeder block will be planted.

Results and Discussion

Survival of transplants was good. Plant vigor overall was good in 2005 and 2006 despite the droughty conditions. Vigor was excellent in 2007 and 2008. Plant color ranges from blue green to green. Plants within some accessions have different growth habits. This is expected for seed collected accessions as parentage could be different. Vigorous, leafy plants would be desirable for revegetating sandy soils. Sand bluestem is generally a poor seed producer. The plants were evaluated in 2008 for flowering time. The final selected plants have similar flowering dates. This is essential for producing seed. Some plants have attractive color and form and may have potential in landscaping.

Plants were evaluated in 2009 for culm production and seed fill. Plants that had good seed fill were thought to be flowering at similar times and had the capability of producing viable seed.

Some leaf rust was observed in 2009, but the disease was not severe on any of the plants. Some plants were not selected because they had characteristics of big bluestem or a cross of big bluestem and sand bluestem.

Plant selection for the breeder population was completed in 2010. Plants preselected in 2009 were the first priority in making the final selections. The final selections were based on seed fill, flowering time, and overall plant health.

Reselection of the breeder population was made in 2012, based on seed fill and plant performance. The origin of the selected plants cannot be positively identified. Based on the blue color, yellow nodes and overall plant form of plants in the original assembly, they appear to be mostly from an accession from Sherburne County, MN.

Table SB-1. Collections – sand bluestem *Andropogon hallii*

Accession	State	County	Date	Legal Description	Collector
9082894	SD	Harding	09/14/03	Sec.30, T15N, R5E SE of N Crow Butte	L.Smith
9082803	ND	Adams	09/02/03	SW1/4 Sec.11 and NE1/4 of Sec.14, T129N, R92W Roadway	J.Klein, J.Timm
9082804	ND	Ransom	09/08/03	Sec. 14 and Sec.23, T135N, R53W Sheyenne Grasslands	N. Jensen
9082805	ND	McHenry	09/24/03	Sec.20, T158N, R75W, Mouse River State Forest	M.Knudson
9082806	ND	McHenry	09/24/03	Sec.13, T153N, R76W road ditch SE of George Lake	M.Knudson
9082807	SD	Corson	09/23/03	Sec.29, T20N, R18E flat area	D.Evenson
9082808	ND	Ransom	09/09/03	Sec.27,34 T135N, R53W 2mi N of Hwy 27 along 147 Ave. N	N. Jensen
9082809	SD	Brown	09/09/03	NE1/4 26, SW1/4 25, T128N, R60W 1mi from Brown/Marshall Co. line	N. Jensen
9082810	SD	Todd	09/19/03	SW1/4 19, T36N, R29W N of county road	L.Schoon
9082811	SD	Todd	09/19/03	NW1/4 Sec.25, T36N, R31W, 3/4mi W Hwy S of St. Francis	L.Schoon
9082812	SD	Todd	09/19/03	SE1/4 Sec.9, T36N, R28W 1/2 mi W of Hwy 83, N edge of county road	L.Schoon
9082824	ND	Billings	10/01/03	SW1/4 Sec.22, T139N, R103W along Little Missouri River	M.Humann
9082827	ND	McHenry	09/15/03	NW1/4 Sec.2, T75N, R154W east of farm	W.Duckwitz
9082881	MT		2003	Sec.25, T11N, R48E	T.Haughain, Kilian
9082904	ND	Burleigh	09/09/03	Sec.7, T137N, R77W Moffit Rd west of curve	Jensen, Bergsagel
9082905	ND	Emmons	09/23/04	4 mi S. of Glencoe Church, Hwy 1804, east side of road	D.Tober
Garden	KS			Received from Manhattan, KS PMC	
sher1	MN	Sherburne	09/04/03	Sec.27, T34N, R27W Sand Dunes State Forest, east exposure	G.Hugo
sher2	MN	Sherburne	09/04/03	Sec.4, T133N, R28W non-cropped pivot corner	B.Gullickson
sher3	MN	Sherburne	09/04/03	SESE Sec.15, T34N, R27W old Christmas tree plantation	G.Hugo
sher4	MN	Sherburne	09/04/03	Sec.24, T34N, R29W Oak Savannah Land preserve (county park)	B.Gullickson
sher5	MN	Sherburne	09/04/03	Sec.16, T34N, R29W & Sec.31, T34, R28 along railroad tracks	B.Gullickson

Figure SB-1. Plot layout - Sand Bluestem *Andropogon hallii*.

(Plants were started in conetainers in the greenhouse from collected seed)

Plant spacing: 42 inches (3.5 ft.)

Row spacing: 42 inches (3.5 ft.)

Plants Selected for Breeder Population



Garden	9082811	9082809	9082806	sher5	9082881
Garden	9082811	9082809	9082806	sher5	9082881
Garden	9082811	9082809	9082806	sher5	9082881
9082827	9082905	9082881	9082807	9082806	sher3
9082827	9082905	9082881	9082807	9082806	sher3
9082827	9082905	9082881	9082807	9082806	sher3
9082810	sher5	9082811	sher3	9082812	9082810
9082810	sher5	9082811	sher3	9082812	9082810
9082810	sher5	9082811	sher3	9082812	9082810
9082809	9082807	sher5	9082810	9082804	Garden
9082809	9082807	sher5	9082810	9082804	Garden
9082809	9082807	sher5	9082810	9082804	Garden
9082806	9082904	9082804	9082812	9082809	9082803
9082806	9082904	9082804	9082812	9082809	9082803
9082806	9082904	9082804	9082812	9082809	9082803
9082803	sher3	Garden	sher2	9082811	9082905
9082803	sher3	Garden	sher2	9082811	9082905
9082803	sher3	Garden	sher2	9082811	9082905
9082808	sher2	9082803	9082904	sher2	9082904
9082808	sher2	9082803	9082904	sher2	9082904
9082808	sher2	9082803	9082904	sher2	9082904
9082881	9082804	9082905	9082808	9082808	9082807
9082881	9082804	9082905	9082808	9082808	9082807
9082881	9082804	9082905	9082808	9082808	9082807
9082812	9082894	9082827	blank	9082827	9082824
9082812	9082894	9082827	blank	9082827	sher4
9082812	9082894	9082827	blank	9082827	sher1

Table SB-2. Evaluations of Selected Plants for Breeder Population- Sand bluestem *Andropogon hallii*.

Key

- Canopy spread:** width of plant, inches
- Culm height:** height of plant including seed culm, inches
- Leaf width:** 1=fine, narrow; 2=medium; 3=wide
- Leafiness:** 1=many leaves; 2=medium; 3=few leaves
- Seed heads:** 1=many; 2=medium; 3=few or none; y=yes; n=no
- Lodging:** 1=none, slight; 2=medium; 3=severe
- Overall size:** 1=large; 2=medium; 3=small
- Stalk strength:** 1=upright; 2=lodged; 3=severe lodging (after winter)
- Phenology:** flowering stage

Date	Accession	Row	Plant No.	(inches) Canopy spread	(inches) Culm height	rating Leaf width	rating Leafiness	rating Seed heads	rating Lodging	rating Overall Size	rating Stalk strength	Phenology	rating Seed Fill	Comments
09/13/05	9082806	1	1					y						
08/04/06	9082806	1	1	29	48	2	1	1						
08/07/07	9082806	1	1				1	1	1	1				gray green
04/03/08	9082806	1	1								1			
07/29/08	9082806	1	1				2					boot		
08/21/09	9082806	1	1						1					
09/22/09	9082806	1	1										1	
09/13/05	9082806	1	3					y						leafy
08/04/06	9082806	1	3	21	51	2	1	1						very upright
08/07/07	9082806	1	3				1	1	1	1				gray green
04/03/08	9082806	1	3								1			
07/29/08	9082806	1	3				1					pre-anthesis		
09/13/05	sher4	6	1					y						
08/04/06	sher4	6	1	26	42	2	1	1						
08/07/07	sher4	6	1					1	1	1				yellow green
04/03/08	sher4	6	1								1			
07/29/08	sher4	6	1				1					pre-anthesis		
08/21/09	sher4	6	1						1					
09/22/09	sher4	6	1										1	
09/13/05	9082806	5	1					y						2 small culms

Date	Accession	Row	Plant No.	(inches) Canopy spread	(inches) Culm height	rating Leaf width	rating Leafiness	rating Seed heads	rating Lodging	rating Overall Size	rating Stalk strength	Phenology	rating Seed Fill	Comments
08/04/06	9082806	5	1	8	48	2	3	1						
08/07/07	9082806	5	1				2	2	1	2				
04/03/08	9082806	5	1								1			
07/29/08	9082806	5	1				2					pre-anthesis		
09/13/05	9082807	4	3					y						flowering
08/04/06	9082807	4	3	26	51	2	3	1						
08/07/07	9082807	4	3				2	2	1	1				
04/03/08	9082807	4	3								1			
07/29/08	9082807	4	3				2					pre-anthesis		
08/21/09	9082807	4	3						1					
09/22/09	9082807	4	3										2	
09/13/05	9082808	1	1					y						
08/04/06	9082808	1	1	21	36	1	1	2						boot
08/07/07	9082808	1	1				1	1	1	1				yellow green
04/03/08	9082808	1	1								1			
07/29/08	9082808	1	1				1					boot		
08/21/09	9082808	1	1						1					
09/22/09	9082808	1	1										3	
09/13/05	9082808	1	2					n						
08/04/06	9082808	1	2	17	45	2	2	2						powder blue, boot
08/07/07	9082808	1	2				2	2	1	2				
04/03/08	9082808	1	2								1			
07/29/08	9082808	1	2				1					boot		
09/13/05	9082881	1	1					y						small
08/04/06	9082881	1	1	20	45	2	2	2						
08/07/07	9082881	1	1				2	2	2	2				
04/03/08	9082881	1	1								1			
07/29/08	9082881	1	1				2					anthesis		
09/13/05	9082881	6	1					n						
08/04/06	9082881	6	1	21	45	2	2	2						
08/07/07	9082881	6	1				2	2	2	2				
04/03/08	9082881	6	1								2			

Date	Accession	Row	Plant No.	(inches) Canopy spread	(inches) Culm height	<i>rating</i> Leaf width	<i>rating</i> Leafiness	<i>rating</i> Seed heads	<i>rating</i> Lodging	<i>rating</i> Overall Size	<i>rating</i> Stalk strength	Phenology	<i>rating</i> Seed Fill	Comments
07/29/08	9082881	6	1				2					pre-anthesis		
08/21/09	9082881	6	1						1					
09/22/09	9082881	6	1										2	
09/13/05	9082905	6	3					y						
08/04/06	9082905	6	3	20	60	3	1	1						big bluestem?
08/07/07	9082905	6	3				1	1	1	1				coarse
04/03/08	9082905	6	3								1			
07/29/08	9082905	6	3				1					pre-anthesis		

ACTIVE STUDIES: TECHNICAL REPORT 2011-2012

Study NDPMC-P-0404-RA

Study Title: Evaluation and Increase of Indiangrass *Sorghastrum nutans*

Objective: The objective of the study is to evaluate and release an Indiangrass with Minnesota origins that is adapted to Minnesota and the Dakotas. Its purpose will be for prairie, forage, and wildlife plantings. The initial purpose of this study was to identify and release an Indiangrass for use in urban and rural landscaping and to identify and release another population of Indiangrass for forage production and wildlife habitat. The objective was changed due to priorities of the PMC program and to changes in seed origin requirements and preferences in Minnesota.

Cooperators: USDA, NRCS, Bismarck Plant Materials Center; University of Minnesota; South Dakota State University, Brookings, South Dakota

Description: Indiangrass is a tall, native, warm-season grass that is bunchy, but has short, stout rhizomes. It grows 2-6 feet in height. The leaves are often a gray-green color and are somewhat stiff and straight. The attractive seedheads are panicles that are reddish gold and softly hairy.

Distribution: Indiangrass is most commonly associated with big bluestem and switchgrass in tallgrass prairies. It is found in southeast Canada, through much of the central and eastern United States, and into Mexico. It is not generally found west of the Great Plains. It prefers deep, well-drained floodplain soils and moister conditions than big bluestem.

Methods and Materials - Initial Assembly

Collection: Portions of plants were dug from an existing Indiangrass nursery at the north corner of the Agronomy Farm, South Dakota State University. The nursery had been planted in the 1970s-1980s from seedlings started from two seed collections, one from Aurora, east of Brookings, South Dakota, and one from an area around Yankton, South Dakota. Plants from the two sources could be distinguished by their leaf width and texture. The Yankton source, which is a more southern source had wider, coarser leaves than the Aurora source plants. Plants that were colorful or had unusual growth favorable for landscaping were flagged in the fall of 2004 by Dwight Tober and Nancy Jensen, PMC personnel; Dr. Mary Meyer, University of Minnesota; and Dr. Arvid Boe, South Dakota State University. Portions of the selected plants were dug the following spring on April 12, 2005, from the Brookings nursery. One portion of each selection was delivered to Dr. Mary Meyer at the University of Minnesota Arboretum, and the remaining portion was taken to the Plant Materials Center. Additional Indiangrass plants were collected at native sites in Minnesota. These were grown only at the PMC.

The plant/root remained dormant in a cool, dark tree cooler prior to greenhouse planting. Plantlets were separated from root chunks collected at SDSU and native locations. Each individual plantlet was planted into Miracle Grow Potting Mix in cone-tainers™ and placed in the greenhouse on April 25, 2005. Propagules were planted on June 7, 2005, to a field plot in panel A. The plants in the greenhouse were very slow to grow in size. Plants were hardened off in the lath house for two weeks prior to planting in the field.

Assembly: See Table IG-1 for accession information.

Planting Plan: Plantlets were planted to a field north of the sand bluestem in Panel A at the PMC. Each accession was planted in a three-plant plot. The accessions were randomized within the three replications. Plants were spaced 42 inches apart and rows were 42 inches apart. See Figure IG-1 for field plot map.

Site Preparation: The field was black fallowed for a few years, then tilled and packed within a week of planting. Previous plant material in the field was *Carex atherodes*.

Planting Method: Plants were hand planted using a specially made dibble bar that produces holes the size and length of roots within the cone-tainers™.

Field Planting Date: 4/12/2005

Maintenance: Weeds have been controlled from 2005-2009 by shallow tilling with a small walk-behind tiller when weeds are small (less than 3 inches) and hand roguing. The plot has received no fertilizer. Irrigation has been minimal. Plants were irrigated in July and on September 23, 2005, and once in July 2006. Plants were not irrigated in 2007-2009. Herbicide was applied only as a spot spray on small Canada thistle patches in 2005 and 2006. The herbicides used were Curtail and Roundup.

Data Collection: Notes on survival and a few comments on color were noted in 2005. This was the transplant year, so no extensive data was collected. Data collected in 2006 included plant height, leafiness, and culms produced. Data was collected twice in 2007. Data collected in September 2007 indicated seed ripeness. Growth stage was rated in 2008. See Table IG-2 for data. Preliminary selections were made for a landscaping population and a forage population. Plants were flagged. The breeder population was reselected in 2009. A decision was made to select only Minnesota origin plants. Data from previous years, flowering date, and overall plant performance in 2009 of Minnesota plants were considered when making plant selections. Growth stage was recorded August 5, 2009. See Table IG-3. The standard of comparison was the variety Tomahawk.

Methods and Materials - Breeder Population

All selected accessions for the breeder population are of Minnesota origins. Selected plants (see Table IG-3) were propagated in the greenhouse. A portion from each selected plant growing in the initial assembly (Panel A) was dug in April 2010 and the root material split into small plantlets. These were planted in containers and grown in the greenhouse until planting to the breeder field (Field D-11). The number of plants propagated and planted to the breeder field for each selected accession is found in Table IG-3. Plantlets were space planted on 6/7/2010. Rows were spaced 42 inches apart and plants within the rows were planted approximately 2 feet apart. A total of 10 rows (approximately 100 ft long) were planted. There was little or no mortality of plants in the breeder block in 2010. The selected accessions appear leafier than Tomahawk Indiangrass and flowering is 1-2 weeks earlier than Tomahawk. A small amount of seed was hand harvested in 2010. A total of 978 grams bulk of clean seed remained after cleaning 6.77 pounds of dirty seed.

In 2011, plants that had ripe seed in early and mid August were considered to be early flowering. These plants were individually sprayed with glyphosate on September 21, 2011. Once the plants died, they were dug and removed from the field. Approximately 10-20 % of the total number of plants in the field were removed. As selected accessions were randomly planted when the breeder field was established, there is no way to determine the exact origin of each removed plant.

In 2012, the 2011 residue was burned on 4/25/2012. Field maintenance included: atrazine at 2 pints/acre applied 5/1/12; fertilizer 46-0-0 at 73#/ac applied 5/16/2012; 2,4 D at 1 oz/gal on 6/12/12; and hand roguing throughout the growing season. Seed was combine harvested on 9/10/2012.

Results and Discussion

Assembly

Plant survival in the greenhouse and field in 2005 was greater than 90 percent. Some color differences between plants were displayed. Plant growth was excellent in 2006, despite drought conditions. Differences in phenology and growth characteristics were exhibited. A few accessions produced viable seed before a killing frost. Some plants displayed an upright stature and color variation, making them desirable for landscaping. Plants that were leafy and had finer leaves showed potential for forage production. Size, color, and leaf width were variable between accessions in 2008. Attempts to measure stalk strength by rating lodging after overwintering was not possible. All plants were standing on 4/3/2008. A major factor in selection of a forage population is expected flowering date, which is important for seed production. The plants were leafy and vigorous. See Table IG-2 for data.

The primary use for Indiangrass will be Minnesota and portions of eastern North Dakota and eastern South Dakota. Minnesota requirements mandating the use of Minnesota origin seed for state funded and other seedings impacted the selection process. Plants selected are leafy and vigorous. Smut, which has not been noticed in past years, was present on many seed heads throughout the evaluation block. Plants with noticeable smut were not selected.

Breeder Field

The plants that remain after removing the very early maturing maintained some variation in flowering dates. The plants also exhibited variation in various plant characteristics including leaf width, and plant height. Seed harvest in 2012 was 67 pounds of dirty seed, which cleaned out to 38 bulk pounds.

Table IG-1. Collections - Indiangrass *Sorghastrum nutans*.

ID No.	Accession	State	County	Location
A1	9091979			A1 - A12 Vegetative material dug 4/12/2005 from Dr. Arvid Boe's assembly at SDSU Agronomy Farm east of campus, just west of I-29 and at SDSU Research Farm near Aurora, east of I-29. Original material had been collected by Dr. Ross of SDSU in the 1970's from the Aurora Prairie east of Brookings.
A2	9091980			
A3	9091981			
A4	9091982			
A5	9091983			
A6	9091984			
A7	9091985			
A8	9091986			
A9	9091987			
A10	9091988			
A11	9091989			
A12	9091990			
Y1	9091991			Y1 - Y14 Vegetative material dug 4/12/2005 from Dr. Arvid Boe's assembly at SDSU Agronomy Farm east of campus, just west of I-29 and at SDSU Research farm near Aurora, east of I-29. Original material had been collected by Dr. Ross of SDSU in the 1970's from a site near Yankton, South Dakota.
Y2	9091992			
Y3	9091993			
Y4	9091994			
Y5	9091995			
Y6	9091996			
Y7	9091997			
Y8	9091998			
Y9	9091999			
Y10	9092000			
Y11	9092001			
Y12	9092002			
Y13	9092003			
Y14	9092004			
L1	9092005	MN	Redwood	U of M SW Outreach and Research Center, Lamberton, near Cottonwood River in native prairie
L2	9092006	MN	Redwood	U of M SW Outreach and Research Center, Lamberton, near Cottonwood River in native prairie
L3	9092007	MN	Redwood	U of M SW Outreach and Research Center, Lamberton, near Cottonwood River in native prairie
K1	9092008	MN	Douglas	near Kensington, MN between road and railroad
P1	9092009	MN	Redwood	coll. 4/13/2005 Lamberton Twp, Sec.29, 2 miles from Revere along Pell Cr., Brian Pfarr landowner
P2	9092010	MN	Redwood	coll. 4/13/2005 Lamberton Twp, Sec.29, 2 miles from Revere along Pell Cr., Brian Pfarr landowner
E1	9092011	MN	Sherburne	coll. 4/13/2005 Elk River FO, Gina Hugo, T33N. R27 NW1/4of SW1/2 sec14
E2	9092012	MN	Sherburne	coll. 4/13/2005 Elk River FO, Gina Hugo, T33N. R27 NW1/4of SW1/2 sec14
E3	9092013	MN	Sherburne	coll. 4/13/2005 Elk River FO, Gina Hugo, T33N. R27 NW1/4of SW1/2 sec14
KN10	9092017	MN	Kittson	SW1/4 SE1/4 Sec.10 T160N R 46W(Norway Township) fine and medium sands, Al Gustafson
KN15	9092018	MN	Kittson	NW1/4 NE1/4 Sec.15 T160N. R46W(Norway Township) loamy fine sand, Al Gustafson
KN30	9092019	MN	Kittson	NE1/4 SE1/4 Sec.30 T160N. R46W(Norway Township) Arveson fine sandy loam, Al Gustafson
Tom1	9092014	ND		PMC field
Tom2	9092015	ND		PMC field
Tom3	9092016	ND		PMC field
Holt		NE		seed from KS PMC, started in the Greenhouse
H1	NONE	MN	Pine	Hinkley FO, Julie Lindner, SCT, Pine Co., MN SE1/4 of NE1/4 Sec.20 T39N R21W - poor root sample

Figure IG-1. Plot layout - Indiangrass *Sorghastrum nutans* .

Species: **Indiangrass** *Sorghastrum nutans*
 Location: **Panel A**
 Planting Date: 6/7/2005
 Spacing between rows = 42 inches (3.5 feet)
 Spacing between plants = 42 inches (3.5 feet)

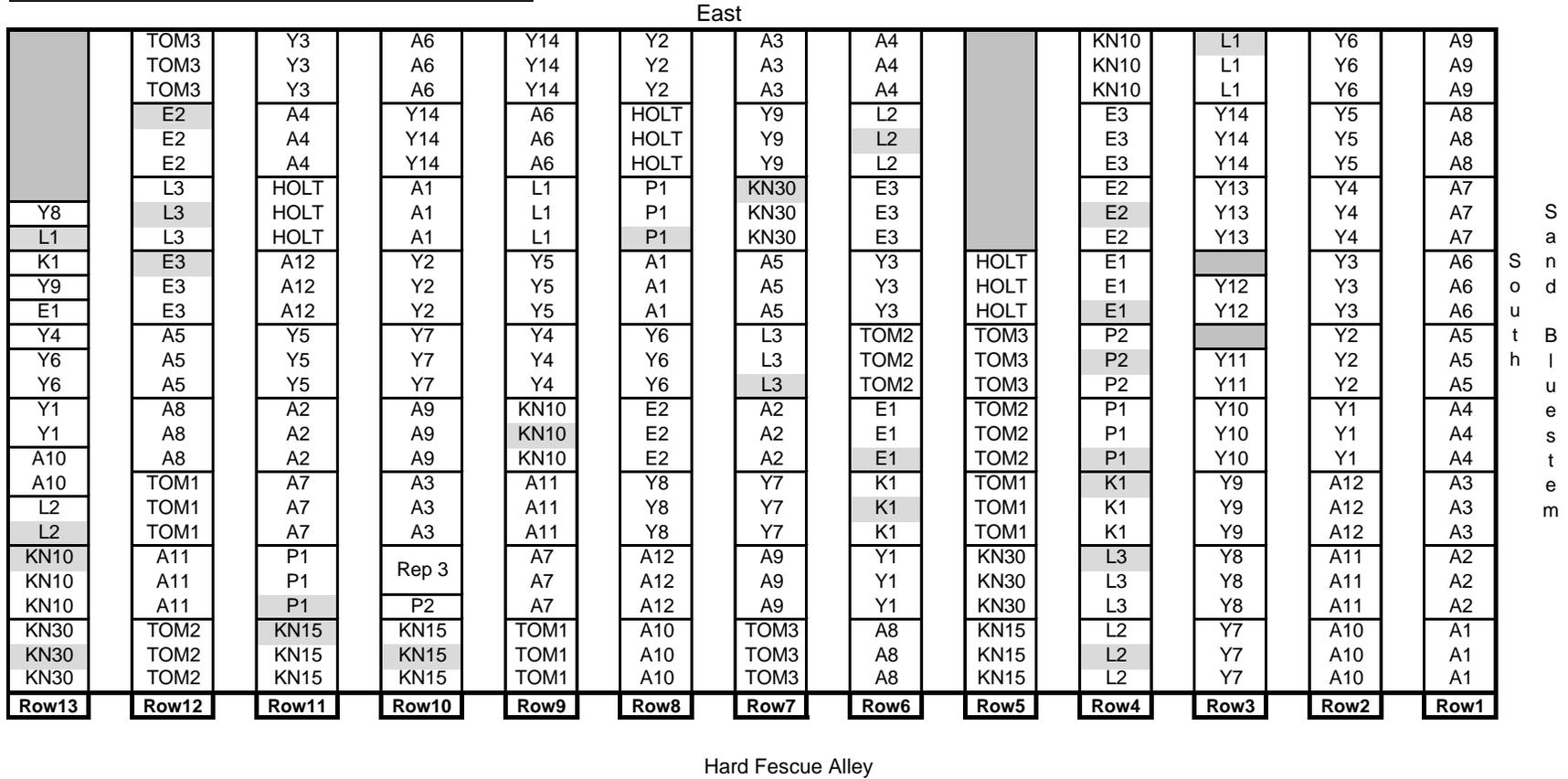
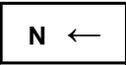


Table IG-2. Evaluation data, 2006-2009 - Indiangrass *Sorghastrum nutans*.

Key:

Ratings

- Leaf width: 1=narrow; 2=medium; 3=wide
- Texture: 1=fine leaves, stem 2=medium 3=coarse leaves, stem
- Leafiness: 1=many leaves; 2=some leaves; 3=few leaves
- Seed culms: 1=many culms; 2=some culms; 3=few culms
- Phenology: 1=seed forming; 2=flowering; 3=boot
- Growth Stage as related to flowering/seed production
- Lodging: 1=no lodging; 2=some lodging; 3=severe lodging
- Plant Size: 1=large, robust; 2=medium to large; 3=small
- Color: 1=very colorful, showy; 2=some color; 3=not showy

- Culm Ht.: seed culm height (inches)
- Spread: width of plant crown (inches)
- Select: L=landscape, F=forage potential selections

Date	Accession	ID No.	Row	Plt. No.	Leaf Width	Texture	Leafiness	Seed Culms	Culm Ht. (in.)	Phenology	Growth Stage	Mature Seed	Spread (in.)	Lodging	Plt. Size	Color	Select	Comments
08/04/06	9092005	L1	3	3	3		1	3	45				24					boot
08/07/07	9092005	L1	3	3			2			2				2	1	2		
09/25/07	9092005	L1	3	3								1						
07/30/08	9092005	L1	3	3		3					boot							
08/9/09	9092005	L1	3	3							No heads							
08/04/06	9092005	L1	13	1	3		1	1	48				35					upright
08/07/07	9092005	L1	13	1			2			2				2	1	1		
09/25/07	9092005	L1	13	1								2						
07/30/08	9092005	L1	13	1		3					boot							
08/09/09	9092005	L1	13	1							No heads							
08/04/06	9092006	L2	4	2	2		1	2	39				34					boot
08/07/07	9092006	L2	4	2			1			3				2	1	2		
09/25/07	9092006	L2	4	2								1						light colored heads
07/30/08	9092006	L2	4	2		2					vegetative							
08/09/09	9092006	L2	4	2							No heads							
08/04/06	9092006	L2	6	2	3		1	2	39				30					boot
08/07/07	9092006	L2	6	2			1			3				1	1	2	F	late
09/25/07	9092006	L2	6	2								1						slight bluegreen
07/30/08	9092006	L2	6	2		2					boot							

Date	Accession	ID No.	Row	Plt. No.	Leaf Width	Texture	Leafiness	Seed Culms	Culm Ht. (in.)	Phenology	Growth Stage	Mature Seed	Spread (in.)	Lodging	Plt. Size	Color	Select	Comments
08/09/09	9092006	L2	6	2							No heads							
08/04/06	9092006	L2	13	1	2		1	2	39				22					boot
08/07/07	9092006	L2	13	1			1			3				2	1	2	F	late
09/25/07	9092006	L2	13	1								1						bluegreen, leafy
07/30/08	9092006	L2	13	1		2					early boot							
08/09/09	9092006	L2	13	1							boot							
08/04/06	9092007	L3	4	3	2		1	2	45				38					boot
08/07/07	9092007	L3	4	3			2			2				2	1	2		
09/25/07	9092007	L3	4	3								1						
07/30/08	9092007	L3	4	3		2					vegetative							
08/09/09	9092007	L3	4	3							No heads							
08/04/06	9092007	L3	7	1	2		1	2	30				29					boot
08/07/07	9092007	L3	7	1			2			2				2	2	2		
09/25/07	9092007	L3	7	1								1						very fine leaf, leafy
07/30/08	9092007	L3	7	1		2					vegetative							
08/09/09	9092007	L3	7	1							No heads							
08/04/06	9092007	L3	12	2	3		1	2	42				28					
08/07/07	9092007	L3	12	2			2			2				2	2	2		
09/25/07	9092007	L3	12	2								1						upright, leafy
07/30/08	9092007	L3	12	2		2					vegetative							
08/09/09	9092007	L3	12	2							No heads							
08/04/06	9092008	K1	4	3	2		2	2	51				34					
08/07/07	9092008	K1	4	3			1			2				2	1	2	F	
09/25/07	9092008	K1	4	3								1						
07/30/08	9092008	K1	4	3		2					vegetative							
08/09/09	9092008	K1	4	3							No heads							
08/04/06	9092008	K1	6	2	2		1	2	54				34					
08/07/07	9092008	K1	6	2			2			2				2	1	2		
09/25/07	9092008	K1	6	2								1						
07/30/08	9092008	K1	6	2		2					boot							
08/09/09	9092008	K1	6	2							No heads							
08/04/06	9092009	P1	4	1	3		1	3	33				37					boot
08/07/07	9092009	P1	4	1			1			2				2	1	2	F	
09/25/07	9092009	P1	4	1								1						

Date	Accession	ID No.	Row	Plt. No.	Leaf Width	Texture	Leafiness	Seed Culms	Culm Ht. (in.)	Phenology	Growth Stage	Mature Seed	Spread (in.)	Lodging	Plt. Size	Color	Select	Comments
07/30/08	9092009	P1	4	1		2					early boot							
08/09/09	9092009	P1	4	1							No heads							
08/04/06	9092009	P1	8	1	3		1	2	30				39					boot
08/07/07	9092009	P1	8	1			2			3				2	1	2	F	late
09/25/07	9092009	P1	8	1								1						
07/30/08	9092009	P1	8	1		2					vegetative							
08/09/09	9092009	P1	8	1							No heads							
08/04/06	9092009	P1	11	1	3		1	2	42				27					boot
08/07/07	9092009	P1	11	1			1			3				2	1	2	F	
09/25/07	9092009	P1	11	1								2						
07/30/08	9092009	P1	11	1		2					early boot							
08/09/09	9092009	P1	11	1							No heads							
08/04/06	9092010	P2	4	2	3		2	3	39				26					boot
08/07/07	9092010	P2	4	2			2			3				2	2	2		
09/25/07	9092010	P2	4	2								2						
07/30/08	9092010	P2	4	2		2					early boot							
08/09/09	9092010	P2	4															
08/04/06	9092011	E1	4	1	2		2	1	63				18					
08/07/07	9092011	E1	4	1			2			2				2	2	2		
09/25/07	9092011	E1	4	1								1						
07/30/08	9092011	E1	4	1		2					late boot							
08/09/09	9092011	E1	4	1														
08/04/06	9092011	E1	6	1	1		1	2	60				26					
08/07/07	9092011	E1	6	1			2			2				2	2	2		
09/25/07	9092011	E1	6	1								1						
07/30/08	9092011	E1	6	1		2					late boot							
08/09/09	9092011	E1																
08/04/06	9092012	E2	4	2	3		2	2	66				18					
08/07/07	9092012	E2	4	2			1			2				2	1	2	F	upright
09/25/07	9092012	E2	4	2								1						
07/30/08	9092012	E2	4	2		2					early anthesis							
08/09/09	9092012	E2																
08/04/06	9092012	E2	12	3	2		1	1	63				18					

Date	Accession	ID No.	Row	Plt. No.	Leaf Width	Texture	Leafiness	Seed Culms	Culm Ht. (in.)	Phenology	Growth Stage	Mature Seed	Spread (in.)	Lodging	Plt. Size	Color	Select	Comments
08/07/07	9092012	E2	12	3			1			1				1	1	2	F	upright, early
09/25/07	9092012	E2	12	3								1						
07/30/08	9092012	E2	12	3		2					late boot							
08/09/09	9092012	E2	12	3														
08/04/06	9092013	E3	12	3	3		2	2	63				22					
08/07/07	9092013	E3	12	3			2			2				2	1	2		
09/25/07	9092013	E3	12	3								1						few leaves
07/30/08	9092013	E3	12	3		2					first anthesis							
08/09/09	9092013	E3	12	3														
08/04/06	9092017	KN10	9	2	2		2	2	48				28					
08/07/07	9092017	KN10	9	2			2			1				2	2	2		black seed
09/25/07	9092017	KN10	9	2								1						bluegreen, fine leaf
07/30/08	9092017	KN10	9	2		1					anthesis							
08/09/09	9092017	KN10	9	2														
08/04/06	9092017	KN10	13	3	3		2	2	45				30					
08/07/07	9092017	KN10	13	3			2			1				2	2	1		black seed, blue leaves
09/25/07	9092017	KN10	13	3								1						fine leaf, basal
07/30/08	9092017	KN10	13	3		1					anthesis							
08/09/09	9092017	KN10	13	3														
08/04/06	9092018	KN15	10	2	2		2	2	51				28					
08/07/07	9092018	KN15	10	2			2			1				1	2	2		
09/25/07	9092018	KN15	10	2								1						short, leaves basal
07/30/08	9092018	KN15	10	2		1					anthesis							
08/09/09	9092018	KN15	10	2														
08/04/06	9092018	KN15	11	3	2		3	2	48				23					
08/07/07	9092018	KN15	11	3			2			1				2	2	2		
09/25/07	9092018	KN15	11	3								1						leaves basal
07/30/08	9092018	KN15	11	3		1					anthesis							
08/09/09	9092018	KN15	11	3														
08/04/06	9092019	KN30	7	3	1		2	2	42				26					
08/07/07	9092019	KN30	7	3			2			1				2	2	2		
09/25/07	9092019	KN30	7	3								1						
07/30/08	9092019	KN30	7	3		1					anthesis							

Date	Accession	ID No.	Row	Plt. No.	Leaf Width	Texture	Leafiness	Seed Culms	Culm Ht. (in.)	Phenology	Growth Stage	Mature Seed	Spread (in.)	Lodging	Plt. Size	Color	Select	Comments
08/09/09	9092019	KN30	7	3							anthesis							
08/04/06	9092019	KN30	13	2	2		1	2	42				31					
08/07/07	9092019	KN30	13	2			2			2				2	2	2		
09/25/07	9092019	KN30	13	2								1						
07/30/08	9092019	KN30	13	2		1					anthesis							
09/22/09	9092019	KN30	13	2							½ anthesis							

Table IG-3. Selections – Indiangrass *Sorghastrum nutans*

Indiangrass Selections 9/22/2009

*plant 1=west most plant of accession

Selections made on appearance, size, seed heads

Breeder block planted 6/7/2010

Accession	ID No.	MN County	Row	Plant*	Total Planted 2010
9092011	E1	Sherburne	4	1	25
9092011	E1	Sherburne	6	1	23
9092012	E2	Sherburne	4	2	25
9092012	E2	Sherburne	12	3	20
9092013	E3	Sherburne	12	3	18
9092008	K1	Douglas	4	3	23
9092008	K1	Douglas	6	2	22
9092017	KN10	Kittson	9	2	25
9092017	KN10	Kittson	13	3	24
9092018	KN15	Kittson	10	2	19
9092018	KN15	Kittson	11	3	21
9092019	KN30	Kittson	7	3	25
9092019	KN30	Kittson	13	2	22
9092005	L1	Redwood	3	3	17
9092005	L1	Redwood	13	1	19
9092006	L2	Redwood	4	2	25
9092006	L2	Redwood	6	2	23
9092006	L2	Redwood	13	1	20
9092007	L3	Redwood	4	3	14
9092007	L3	Redwood	7	1	22
9092007	L3	Redwood	12	2	22
9092009	P1	Redwood	4	1	19
9092009	P1	Redwood	8	1	22
9092009	P1	Redwood	11	1	15
9092010	P2	Redwood	4	2	21

ACTIVE STUDIES: TECHNICAL REPORT 2011-2012

Study: NDPMC-P-0604-RA

Study Title: Evaluation of Prairie Junegrass (*Koeleria macrantha*)

Introduction: Prairie junegrass is a cool-season native grass that grows in small tufts. It has been described as excellent forage for livestock, deer, and elk early in the spring. As the grass is small, its production is low. The quality declines at maturity. It is one of the earliest grasses to begin vegetative growth in the spring. It is easily overgrazed and decreases with increased grazing pressure. It is a component of many native plant communities. No adapted release of prairie junegrass is currently available for revegetation and native seedings in the Northern Great Plains.

Objective: The purpose of this study is to evaluate, identify and assemble a population of prairie junegrass from Minnesota, North Dakota, and South Dakota origins into a public release for conservation seedings in the Northern Great Plains.

Cooperators: USDA, NRCS, Bismarck Plant Materials Center, Bismarck, North Dakota

Description: Prairie junegrass is a short to medium lived, cool-season, perennial bunchgrass that is 6-20 inches tall. The roots are fibrous. Leaves are mostly basal. The seed head is a condensed panicle that opens slightly during flowering. Growth in the spring is usually completed by mid-June.

Distribution: Junegrass is native to most of North America, except the far southeast. It is also native to Europe and Northern Asia. It is very common in mixed grass and shortgrass prairie, meadows, open forest, mountain foothills, and rangeland. It is best adapted to well-drained soils in 12-20 inch precipitation areas.

Methods and Materials

Collection/Assembly: Seed heads were collected in 2006 and 2007 by NRCS employees from Minnesota, North Dakota, and South Dakota. See Table PJ-1 for collection and origin information. Seed heads were clipped at maturity and sent to the Plant Materials Center where they were accessioned and placed in the seed cooler for storage until seed was separated and planted in the greenhouse. Seed was planted into a soilless potting mix in cone-tainers™. Seedlings were planted from the greenhouse to a field plot (Panel A) on 5/21/2008. Seedlings were hand planted using a custom made dibble bar. See Figure PJ-1 for a map of the planting. Some collections did not have viable seed or emerge in the greenhouse. Plants were irrigated after planting to fill any space around the roots.

Maintenance:

2009: Weeds were controlled by shallow tilling between the rows with a garden tiller and hand hoeing around plants.

2010: Weeds were controlled by shallow tillage between rows, and hand hoeing around plants

2011: Weeds were controlled by shallow tillage between rows, and hand hoeing around plants. Plant residue was removed by mowing in early fall.

2012: Mowing between rows was used to control weeds.

Data Collection:

2009: Superior looking plants were grouped into categories based on growth habit and the use of the plant. The categories included landscaping, prairie/range or both. These are indicated in Table PJ-2.

2010: Data was collected in June for each plant. Plants were rated for height, number of culms, leafiness, and growth stage. Data for all plants is found in the previous Technical Report (2010).

2011: Plants that were dead or had poor vigor, disease, or flowered very early or very late were dug and removed from the planting. Superior plants of the remaining plants were noted and categorized as forage or landscape type plants. The removed plants are indicated on the map (Figure PJ-1) All data for the plants that remained after 2011 selection are recorded in Table PJ-2.

2012: Most of the stand was dead in the spring of 2012. As rows within the planting could not be identified, individual remaining plants could not be identified by accession. Seed was hand harvested from the remaining plants in the late summer of 2012. The amount of clean seed harvested was 0.29 bulk pounds.

Results and Discussion

Seed fill is difficult to determine in prairie junegrass. Plants in the greenhouse were small to handle, but transplanting from flats to cone-tainers™ was very successful. Seedling survival after planting to the field was greater than 90 percent. Most of the plants flowered or had seed heads in 2009. Plants showed an array of sizes. Wide variability in size exists among the plants. Some plants are also very hairy on the leaves and stem, while others are smooth.

The loss of the stand in 2012 was very unexpected. Lack of snow cover and extreme cold in the winter of 2011 may have been a contributing factor. Mowing in the fall of 2011 may contributed to the loss as well.

The exact origin of the seed harvested in 2012 is not known. Based on accessions removed in 2011, it is known which collections are not included in the harvest.

Tentative plans are to evaluate plants grown from the harvested seed and make reselections.

Table PJ-1. Collections - Prairie junegrass *Koeleria macrantha*.

Accession	Collector	Date	State	County	Location	Other
9092070	Knudson, Aune	7/19/06	ND	Ward	SE1/4SW1/4 sec 2, T152N, R84W	
9092071	D. Tober	8/16/06	ND	Oliver	MLRA 54, Arroda Lakes GMA	
9092072	D. Tober	8/16/06	ND	Dunn	1/2 mi. W. of Missouri River State Park Hdqtrts	
9092073	A. Berg	8/4/06	ND	Bowman	sec 22, T130N, R104W	S exp., MLRA 54, cobbart compl.
9092074	D. Teske	7/19/06	ND	Sioux	sec 22, T129N, R83W	Daglum soils
9092075	D. Teske	7/17/06	ND	Sioux	sec 9, T132N, R79W	Prairie Knight Casino entrance
9092076	Anderson, Simonsen	7/11/06	ND	Stutsman	sec 2, T141N, R64W	
9092077	C. Roth	6/27/06	ND	Bottineau	sec 16, T162N, R 75W	
9092078	L. Huether	7/5/06	ND	Mountrail	sec 35, T 92N, R 154W	Fred Evans, native range
9092079	L. Huether	7/5/06	ND	Mountrail	sec 17, T 92N, R 157W	Dustin Roise, lightly grazed
9092080	S. Sieler	7/20/06	ND	McLean	SE1/4 sec 16, T 147N, R 79W	MLRA 53B, state school land
9092081	S. Sieler	7/20/06	ND	McLean	SW1/4 sec 16, T 149N, R 79W	state school land
9092082	W. Duckwitz	7/25/06	ND	Grant	S1/2 sec 14, T 135N, R 88W	Heart Butte Dam, hilltop (2 samples)
9092083	Area 1-Thief River FO	7/20/06	MN	Kittson	Norway Dunes TNC, 4 mi to Halma	north end of unit
9092084	D. Teske	7/12/06	ND	Sioux	N1/2 NW1/4 sec 36, T 131N, R 84W	
9092085	D. Tober, R. Jones	7/21/06	ND	Wells	8 mi N. of Hurdsville, Wells Co. GMA	
9092086	D. Teske	7/12/06	ND	Sioux	SW NE1/4 sec 27, T 130N, R 83 W	
9092087	L. Huether	7/5/06	ND	Mountrail	sec 20, T92N, R154W	
9092088	L. Huether	7/5/06	ND	Mountrail	sec 30, T 92N, R 156W	Curt Trulson land
9092089	L. Huether	7/5/06	ND	Mountrail	sec 21, T 92N, R 159W	Denny Farhart
9092090	W. Duckwitz	6/29/06	ND	Morton	NE1/4 sec 1, T82N, R 140W	north of buildings
9092091	R. Jones	7/25/06	ND	Morton	sec 16, T 139N, R 85W	right behind New Salem Sue
9092092	Forman, Gustafson	7/10/06	ND	Rolette	SE1/4 NW1/4 sec 1, T160N, R 72W	
9092093	D. Teske	7/8/06	ND	Morton	SW SW1/4, sec 14, T138N, R 81W	Teske acreage, Co. Rd. 138
9092094	D. Teske	8/7/06	SD	Corson	sec 13-T20-R27 by EQIP well/tank site	Reeder Loam
9092095	Jensen, Bergsagel	8/9/06	SD	Spink	N1/2 sec 21, T116N, R 65W	Bald Mtn. near Redfield (2 samples)
9092096	D. Teske	7/18/06	SD	Corson	SE1/4 sec 9, T18N, R 21E	Cottonwood Creek
9092097	Jensen, Bergsagel	8/10/06	SD	Deuel	NE1/4 sec 16, T116N, R49W	8 mi N. of Clear Lake along GMA fence
9092098	Jensen, Bergsagel	8/9/06	SD	Faulk	sec 28, 33 T117N, R69W	8 mi south Faulkton
9092099	Jensen, Bergsagel	8/10/06	SD	Codington	sec 13, T119N, R51W	along hwy 20
9092100	Yapp, Schoon	7/12/06	SD	Todd	SE Harrington, 5 mi, 20 mi SW of Rosebud	

Accession	Collector	Date	State	County	Location	Other
9092101	Teske	7/18/06	SD	Corson	SE1/4 sec 8, T18N, R21E	Cottonwood Creek
9092102	Woods, Sommer	7/11/06	SD	Hutchinson	sec 9, T99N, R57W	Harvey Wall-owner
9092103	R. Jones	7/18/06	MN	Ottertail	Inspiration Peak, 12 mi NE of Ashby	
9092104	Rennolet, Woods	7/11/06	SD	Hutchinson	8 mi SE of FO, Dennis Farst, landowner	(2 samples)
9092105	R. Jones	7/17/06	MN	Clay	TNC Bluestem Prairie, 10 mi E. of Moorhead	
9092106	S. Runyan	7/7/06	SD	Hyde	sec 6, T111N, R72W	section line fence
9092107	Jensen, Harding 4-H	7/10/06	SD	Harding	North Cave Hills	
9092108	R. Jasken	summer 06	MN	Becker	sec 18, T142N, R41W	
9092109	Hanson, Bronder	7/14/06	MN	Sherburne	SW1/4 SW1/4 sec 26, T34N, R27W	
9092110	R. Jones	7/18/06	MN	Douglas	TNC Seven Sisters, 3 mi E of Ashby	
9092111	D. Tober	7/24/06	MN	Pope	Ordway Prairie TNC 9 mi se of Brooten, MN	NE of rest stop
9092112	Area 1-Thief River FO	7/20/06	MN	Kittson	Norway Dunes TNC, 4 mi to Halma	south end of unit
9092113	L. Alveshere	7/18/06	ND	McKenzie	NENW sec 15, T152N, R101W	Donald Lindvig
9092114	Blessum, Forman	7/5/06	ND	McHenry	sec 15, T157N, R78W	
9092115	L. Alveshere	8/16/06	ND	McKenzie	NENE sec 16, T149N, R99W	Gene Traustrom
9092116	Jones, Tober	7/20/06	MN		Agassis Dunes TNC 3 mi S. of Fertile	
9092117	L. Alveshere	7/19/06	ND	McKenzie	SWNE sec 25, T149N, R 95W	Arnold Peterson
9092118	L. Alveshere	7/6/06	ND	McKenzie	SESE sec 5, T150N, R96W	Tank Ranch
9092119	L. Alveshere	7/24/06	ND	McKenzie	NESE sec 19, T146N, R103W	John Quinnet, Milt Madison
9092120	Gustafson, Jones	7/20/06	MN		Skull Lake WMA 14 mi N. of Lake Bronson	
9092121	D. Tober	9/26/06	ND	Burleigh	McDowell Dam	from 15 plants
9092123	D. Tober	9/26/06	ND	Stutsman	10 mi N. Medina, WPA, W. side of highway	
9092124	D. Tober	9/12/06	MN	Big Stone	4 mi W. of Beardsley Paradise Retreat Dev.	
9092125	D. Tober	9/26/06	ND	Burleigh	WMA N. of Apple Valley Housing Dev.	
9092126	D. Tober	10/2/06	ND	Grant	across from Crappie Creek, Lake Tschida	
9092133	M. Rose	7/25/06	MN	Renville	sec 21, T113N, R35W Cnty. Rd. 15	native bedrock, MN River
9092134	M. Rose	7/25/06	MN	Redwood Falls	NE1/4 sec 23, T112N, R34W	native pasture (rock outcrops)
9092135	L. Voigt	7/3/06	ND	Dunn	SWNE sec 30-T147-R93,w. saltbox	Andrew Voigt Ranch
9092136		7/24/06	SD	Brown	SW sec 2-T125-R63	1330 ft. elev. Slope2%
9092177	D. Tober	8/31/07	ND	Ransom	Sheyenne National Grasslands, north trail	147th Ave.(co.53) 2 mi N. of Hwy 27
9092178	D. Tober	8/31/07	ND	Ransom	S. of McLeod approx. 1 mi.,Sheyenne Grasslands	west side of gravel road
9092179	D. Tober	8/30/07	MN	Pope	near Ordway Prairie SNA, TNC	W. of Brooten 7 mi.
9092180	D. Tober	8/30/07	MN	Polk	near Agassiz Dunes SNA, TNA	
9092181	D. Tober	8/30/07	MN	Clay	Regional Science Center	4 mi. E. of Glyndon

Accession	Collector	Date	State	County	Location	Other
9092182	D. Tober	9/26/07	WY	Cook	NFS campgrounds, 3 mi NE of Sundance, WY	BHNF trailhead Bearlodge MT.
9092183	D. Tober	9/26/07	WY	Cook	Bearlodge MT. BHNF Cook Lake Rec. Area	1 mi down Cliff Swallow Trail
9092184	D. Tober	9/26/07	WY	Cook	3mi. S. of Beulah, WY Sand Creek Access	
9092185	D. Tober	9/26/07	WY	Cook	Bearlodge MT. BHNF Warren Peak Lookout Tower 6656'	
9092186	D. Tober	9/26/07	WY	Cook	4 mi NW Sundance, BHNF BearLodge Mts.	Reuter Trailhead
9092187	D. Tober	9/28/07	ND	Dunn	1/4 mi S. from maintenance sign to Killdeer Mtns	GMA west side of road
9092188	D. Tober	9/25/07	SD	Meade	summit of Bear Butte E. of Sturgis	N. facing slope
9092189	D. Tober	9/25/07	SD	Meade	2/3 up Bear Butte, E. of Sturgis north facing slope	4200 ft
9092190	D. Tober	9/27/07	ND	Slope	near entrance to Burning Coal Vein, in pines	
9092191	D. Tober	9/27/07	ND	Slope	12 mi W. of Amidon on Burning Coal Vein Rd.	
9092192	D. Tober	9/27/07	ND	Billings	S. of Medora along Little Missouri River bank	
9092193	D. Tober	9/27/07	SD	Harding	Slim Butte Rest Stop, USFS	Hwy 20 W of Reva, SD
9092194	M. Knudson	8/12/07	ND	Slope	sec 25-T134N-R101W	N side of White Butte
9092195	D. Teske	7/12/07	ND	Sioux	sec 26&27-T130-R83	6 mi. W of Selfridge
9092196	C. Dixon	7/1/07	ND		Sully's Hill Native Prairie	
9092197	M. Bellon	7/15/07	ND	Burleigh	sec. 17- T138N-R79W 1mi s. of Lincoln Rd.	1.5 mi E.
9092198	W. Duckwitz	9/6/07	ND	Stark	NE1/4NE1/4sec 16-T141-R91	Rick Schwartz land
9092199	C.Stange, W.Duckwitz	9/6/07	ND	Stark	SW1/4SE1/4 sec 4-T141-R91	Rick Schwartz land
9092200	D. Granbois	8/27/07	SD	Brookings	NE1/4 sec.18-T112N-R47W	Lake Hendricks Township
9092201	J. Dylla, V. DeVine	8/29/07	SD	Clark	sec1-T118-R56	
9092202	Yankton FO	7/1/07	SD	Yankton		
9092203	A. Boltjes	7/19/07	SD	Hyde	sec16-T115N-R73W	
9092204	L. Schoon	8/23/07	SD	Todd	SW1/4 sec10-T38N-R33W	Elk Valley, Inc.
9092205	N. Jensen, D. Tober	7/23/07	SD		Emergency Spillway W. of Oahe Dam	northwest of Pierre, SD
9092206	N. Jensen, D. Tober	7/24/07	SD		Sage Creek Road, SD Badlands	
9092207	L. Schoon	8/15/07	SD	Todd	SW1/2 29-T36N-R25W	Casey Foster Land, sands
9092208	D. Blaha	8/1/07	SD	Sully	sec. 26 T116N-R80W	.5 mi SE of river
9092209	T. Heck	8/1/07	SD	Potter	sec. 28-T117N-R79W	adj to north facing riparian area
9092210	B Woods, T. Sommer	7/13/07	SD	Hutchinson	sec. 31-T99-R58	south of barn
9092211	D.Tober, M. Knudson	10/11/07	MT	Powder River	2 mi. W of Diamond Butte Lookout, W.of Broadus	
9092214	M. Falk	8/24/07	SD	Hand	sec 9-T116-R67	silt loam, 0-2% slope
9092225	Paul Hoversten	9/1/07	MN	Lyon	E1/2 NE1/4 Sec 22 Island Lake Township	

Table PJ-2. 2010 evaluation data and 2011 selection - Prairie junegrass *Koeleria macrantha*

- * Height: 1=tall, 3=short
- ** Culms: 1=many, 3=few or none
- *** Leafiness: 1=leafy, 3=few leaves
- **** Maturity: H=heading, A=anthesis, B=boot, V=vegetative, X=no plant

Accession	Row	Plant	Date	* rating Height	** rating Culms	*** rating Leafiness	**** Maturity	Remarks	2011 Selection
9092070	6	1	6/7/2010	2	1	1	H		
9092070	6	3	6/7/2010	2	1	1	H		
9092070	21	1	6/7/2010	2	1	1	H		
9092070	21	2	6/7/2010	2	3	3	H		
9092070	21	3	6/7/2010	2	1	1	H		
9092070	25	1	6/7/2010	2	1	1	H		
9092070	25	2	6/7/2010	2	2	2	H		
9092070	25	3	6/7/2010	2	1	1	H		
9092071	8	1	6/7/2010	2	2	3	H	thrips	
9092071	8	2	6/7/2010	1	2	2	H	leaf disease	
9092071	8	3	6/7/2010	1	1	1	H	nice plant	
9092071	21	1	6/7/2010	1	2	2	H	thrips	
9092071	21	2	6/7/2010	1	2	2	H		
9092071	21	3	6/7/2010	1	2	2	H		
9092071	26	1	6/7/2010	2	2	2	H		
9092071	26	2	6/7/2010	2	2	2	A		
9092071	26	3	6/7/2010	1	1	1	H		
9092072	4	1	6/7/2010	1	1	2	H		
9092072	4	3	6/7/2010	2	2	2	H		
9092072	21	1	6/7/2010	1	1	1	H		
9092072	21	2	6/7/2010	2	2	3	H		
9092072	21	3	6/7/2010	1	2	2	H		
9092072	23	2	6/7/2010	1	1	1	H		forage
9092072	23	3	6/7/2010	1	1	2	H		
9092073	7	1	6/7/2010	2	2	1	H		
9092073	7	2	6/7/2010	2	2	3	H		
9092073	7	3	6/7/2010	1	1	1	H		
9092073	21	2	6/7/2010	2	2	3	H		
9092073	28	1	6/7/2010	2	2	2	H		
9092073	28	2	6/7/2010	2	1	2	H		
9092073	28	3	6/7/2010	1	1	1	A		
9092075	6	2	6/7/2010	2	2	2	H		
9092075	6	3	6/7/2010	1	1	1	H		
9092075	20	1	6/7/2010	1	2	2	H		
9092075	20	2	6/7/2010	2	1	1	H		
9092075	20	3	6/7/2010	1	2	2	H	Insects	
9092075	22	1	6/7/2010	2	1	2	H		
9092075	22	2	6/7/2010	2	1	2	H		
9092075	22	3	6/7/2010	2	1	2	H		

Accession	Row	Plant	Date	* rating Height	** rating Culms	*** rating Leafiness	**** Maturity	Remarks	2011 Selection
9092076	8	1	6/7/2010	2	2	3	H		
9092076	8	2	6/7/2010	3	2	3	H		
9092076	8	3	6/7/2010	2	1	2	H		
9092076	20	1	6/7/2010	2	2	2	H		
9092076	20	2	6/7/2010	2	2	3	H		
9092076	20	3	6/7/2010	2	2	2	H		
9092076	23	1	6/7/2010	2	3	3	H		
9092076	23	2	6/7/2010	2	1	2	H	insects	
9092076	23	3	6/7/2010	1	1	2	H	leaf disease	
9092077	2	1	6/7/2010	1	1	2	H	diseased	
9092077	2	2	6/7/2010	1	2	2	H		
9092077	2	3	6/7/2010	3	3	3	H	stressed	
9092077	14	1	6/7/2010	2	1	1	H		
9092077	14	3	6/7/2010	1	1	2	H		
9092077	30	1	6/7/2010	2	1	1	H		
9092077	30	2	6/7/2010	2	2	2	H		
9092077	30	3	6/7/2010	2	2	2	H		
9092078	4	1	6/7/2010	1	1	1	A		
9092078	4	2	6/7/2010	2	1	2	H		
9092078	4	3	6/7/2010	1	1	2	H		turf
9092078	14	1	6/7/2010	2	1	1	H		
9092078	14	2	6/7/2010	2	2	2	H		
9092078	14	3	6/7/2010	2	1	1	H		
9092078	29	1	6/7/2010	1	1	2	H		
9092078	29	2	6/7/2010	1	1	2	H		turf
9092078	29	3	6/7/2010	1	2	2	H		
9092079	6	1	6/7/2010	1	2	2	H		
9092079	6	2	6/7/2010	2	1	2	H		
9092079	13	1	6/7/2010	2	1	3	H	diseased	
9092079	13	2	6/7/2010	1	1	1	H		
9092079	13	3	6/7/2010	2	1	2	H		
9092079	31	1	6/7/2010	2	2	2	A		
9092079	31	2	6/7/2010	1	2	2	H		
9092079	31	3	6/7/2010	2	1	1	H		
9092080	4	1	6/7/2010	1	1	2	H		
9092080	4	2	6/7/2010	2	1	1	H		
9092080	4	3	6/7/2010	3	2	2	H	diseased	
9092080	13	1	6/7/2010	2	2	2	H		
9092080	13	2	6/7/2010	1	2	1	H		turf
9092080	13	3	6/7/2010	2	2	2	A		
9092080	30	3	6/7/2010	2	1	1	H		
9092081	4	1	6/7/2010	3	2	3	H		
9092081	13	1	6/7/2010	2	2	1	H		
9092081	13	2	6/7/2010	2	2	2	H		
9092081	13	3	6/7/2010	2	2	3	H		

Accession	Row	Plant	Date	* rating Height	** rating Culms	*** rating Leafiness	**** Maturity	Remarks	2011 Selection
9092081	28	1	6/7/2010	2	2	2	H		
9092081	28	2	6/7/2010	2	2	2	H		
9092081	28	3	6/7/2010	2	2	1	H		turf
9092082	2	1	6/7/2010	2	2	3	H	diseased	
9092082	2	2	6/7/2010	3	3	2	H		
9092082	2	3	6/7/2010	1	1	2	H		
9092082	13	1	6/7/2010	1	2	2	H		
9092082	13	3	6/7/2010	1	1	1	H		forage
9092082	26	1	6/7/2010	1	2	2	H		
9092082	26	2	6/7/2010	1	2	1	H		
9092082	26	3	6/7/2010	1	1	1	H		
9092083	1	1	6/7/2010	1	1	2	H		
9092083	1	2	6/7/2010	2	2	2	H		
9092083	1	3	6/7/2010	3	3	3	H		
9092083	13	1	6/7/2010	2	2	2	H		
9092083	13	2	6/7/2010	2	1	2	H		
9092083	13	3	6/7/2010	2	1	2	H		
9092083	28	1	6/7/2010	1	1	2	H		
9092083	28	2	6/7/2010	1	2	1	H		forage
9092083	28	3	6/7/2010	1	2	2	H		
9092084	2	2	6/7/2010	1	1	1	H		forage
9092084	2	3	6/7/2010	2	2	3	H		
9092084	19	1	6/7/2010	1	2	2	H		
9092084	19	2	6/7/2010	2	2	2	H	leaf disease	
9092084	19	3	6/7/2010	2	2	2	H		
9092084	23	1	6/7/2010	1	2	2	H		
9092084	23	2	6/7/2010	3	3	3	H		
9092084	23	3	6/7/2010	1	1	1	H		
9092085	8	1	6/7/2010	2	2	2	H		
9092085	8	2	6/7/2010	2	3	2	H	Insects	
9092085	8	3	6/7/2010	3	3	3	H		
9092085	19	1	6/7/2010	2	2	1	H		
9092085	19	2	6/7/2010	2	1	1	H		forage
9092085	19	3	6/7/2010	2	2	2	H	insects and disease	
9092085	22	1	6/7/2010	2	2	2	H		
9092085	22	2	6/7/2010	2	3	3	H		
9092085	22	3	6/7/2010	2	1	2	H		
9092086	8	1	6/7/2010	2	2	2	H		
9092086	8	2	6/7/2010	2	2	1	H		
9092086	8	3	6/7/2010	2	3	3	H		
9092087	4	1	6/7/2010	2	1	1	H		
9092087	4	2	6/7/2010	2	2	3	H		
9092087	4	3	6/7/2010	1	2	1	H		
9092087	19	1	6/7/2010	2	2	2	H		
9092087	19	2	6/7/2010	2	2	2	H		

Accession	Row	Plant	Date	* rating Height	** rating Culms	*** rating Leafiness	**** Maturity	Remarks	2011 Selection
9092087	19	3	6/7/2010	2	1	1	H		
9092087	22	1	6/7/2010	2	2	2	H		
9092087	22	2	6/7/2010	3	3	2	H		
9092087	22	3	6/7/2010	3	3	3	H		
9092088	7	1	6/7/2010	1	2	3	H		
9092088	19	1	6/7/2010	1	1	1	H		
9092088	19	2	6/7/2010	2	2	1	H		
9092088	19	3	6/7/2010	2	2	2	H		
9092088	21	1	6/7/2010	2	2	2	H		
9092088	21	2	6/7/2010	2	1	1	H	bluegrass contaminant	
9092088	21	3	6/7/2010	2	2	2	H		
9092089	6	1	6/7/2010	3	3	3	H		
9092089	6	2	6/7/2010	3	3	3	H		
9092089	6	3	6/7/2010	3	1	2	H		turf
9092089	18	1	6/7/2010	2	1	1	H		
9092089	18	2	6/7/2010	3	3	3	H		
9092089	18	3	6/7/2010	2	2	2	H		
9092089	24	1	6/7/2010	2	1	2	H		
9092089	24	2	6/7/2010	1	1	1	H		turf
9092089	24	3	6/7/2010	2	1	1	H		
9092090	7	1	6/7/2010	2	2	1	H		
9092090	7	2	6/7/2010	1	1	1	H		forage
9092090	7	3	6/7/2010	1	1	1	H		
9092090	18	1	6/7/2010	2	1	2	H		
9092090	18	2	6/7/2010	1	1	2	H		
9092090	18	3	6/7/2010	2	2	2	H		
9092090	25	1	6/7/2010	2	1	2	H		
9092090	25	2	6/7/2010	2	1	1	H		
9092090	25	3	6/7/2010	2	1	2	H		
9092091	3	1	6/7/2010	1	1	1	H	upright	
9092091	3	2	6/7/2010	2	2	2	H		
9092091	3	3	6/7/2010	2	1	2	H		
9092091	17	1	6/7/2010	1	1	2	H	diseased	
9092091	17	2	6/7/2010	3	3	2	V		
9092091	17	3	6/7/2010	3	2	2	H		
9092091	27	1	6/7/2010	1	1	1	H		
9092091	27	2	6/7/2010	2	1	2	H		turf
9092091	27	3	6/7/2010	1	1	1	H		
9092092	6	1	6/7/2010	2	3	3	H		
9092092	6	2	6/7/2010	2	1	2	H		
9092092	6	3	6/7/2010	2	3	2	H		
9092092	17	1	6/7/2010	2	2	1	H	leafy turf type	turf
9092092	17	3	6/7/2010	1	1	2	H		
9092092	31	1	6/7/2010	0	0	0	X		

Accession	Row	Plant	Date	* rating Height	** rating Culms	*** rating Leafiness	**** Maturity	Remarks	2011 Selection
9092092	31	3	6/7/2010	0	0	0	X		
9092093	3	1	6/7/2010	1	2	3	H		
9092093	3	2	6/7/2010	2	2	3	H		
9092093	3	3	6/7/2010	1	1	2	H		
9092093	17	1	6/7/2010	1	2	2	H		forage
9092093	17	2	6/7/2010	2	2	2	H		
9092093	17	3	6/7/2010	2	2	2	H		
9092093	29	1	6/7/2010	2	2	2	H		
9092093	29	2	6/7/2010	2	1	1	H		
9092093	29	3	6/7/2010	1	1	2	H		
9092095	6	1	6/7/2010	1	2	2	H		
9092095	6	2	6/7/2010	2	2	2	H		
9092095	17	1	6/7/2010	2	2	2	H		
9092095	17	2	6/7/2010	2	3	2	H		
9092095	17	3	6/7/2010	2	2	3	H		
9092095	31	1	6/7/2010	1	2	1	H		
9092095	31	2	6/7/2010	3	3	2	H		
9092095	31	3	6/7/2010	2	3	3	H		
9092097	5	1	6/7/2010	3	1	2	H		
9092097	17	1	6/7/2010	2	2	2	H		
9092097	17	2	6/7/2010	2	1	2	H		
9092097	17	3	6/7/2010	2	2	2	H		
9092097	27	1	6/7/2010	2	1	2	H		
9092097	27	2	6/7/2010	2	2	2	H		
9092097	27	3	6/7/2010	2	2	2	H		
9092098	8	1	6/7/2010	2	2	2	H		
9092098	8	2	6/7/2010	2	1	1	H		
9092098	8	3	6/7/2010	3	2	3	H		
9092098	14	1	6/7/2010	2	2	2	H		
9092098	14	2	6/7/2010	3	2	2	H		
9092098	14	3	6/7/2010	3	2	2	H		
9092098	26	1	6/7/2010	2	1	1	H		
9092098	26	2	6/7/2010	2	2	2	H		
9092098	26	3	6/7/2010	2	1	1	H		
9092099	5	1	6/7/2010	2	2	3	H		
9092099	5	2	6/7/2010	3	3	3	H		
9092099	5	3	6/7/2010	2	3	3	H		
9092099	14	1	6/7/2010	2	2	3	H		
9092099	14	2	6/7/2010	2	2	2	H		
9092099	14	3	6/7/2010	2	2	2	H		
9092099	24	1	6/7/2010	2	1	2	H		
9092099	24	2	6/7/2010	2	1	1	H		
9092099	24	3	6/7/2010	2	2	2	H		
9092100	7	1	6/7/2010	2	3	3	H		
9092100	7	2	6/7/2010	2	2	2	H		

Accession	Row	Plant	Date	* rating Height	** rating Culms	*** rating Leafiness	**** Maturity	Remarks	2011 Selection
9092100	7	3	6/7/2010	0	0	0	X		
9092100	14	1	6/7/2010	2	2	2	H		
9092100	14	2	6/7/2010	2	2	2	H		
9092100	14	3	6/7/2010	2	2	2	H		
9092100	22	1	6/7/2010	2	1	1	H		
9092100	22	2	6/7/2010	2	1	1	H		
9092100	22	3	6/7/2010	2	2	2	H		
9092101	1	2	6/7/2010	1	2	2	H		
9092101	1	3	6/7/2010	2	2	1	H		
9092101	14	1	6/7/2010	1	1	1	H		
9092101	14	2	6/7/2010	2	2	1	H		
9092101	14	3	6/7/2010	2	2	1	H		
9092101	27	1	6/7/2010	1	1	2	H		
9092101	27	2	6/7/2010	1	2	2	H		
9092101	27	3	6/7/2010	1	1	2	H		
9092102	1	1	6/7/2010	2	2	2	H	some disease	
9092102	1	2	6/7/2010	3	3	3	H		
9092102	14	1	6/7/2010	2	2	2	H		
9092102	14	2	6/7/2010	2	3	1	V	veg, no heads	
9092102	14	3	6/7/2010	2	2	2	B		
9092102	29	1	6/7/2010	1	1	1	H		
9092102	29	2	6/7/2010	1	1	1	H		forage
9092102	29	3	6/7/2010	2	2	1	H		turf
9092103	3	1	6/7/2010	2	2	3	H		
9092103	3	2	6/7/2010	1	1	2	H		
9092103	3	3	6/7/2010	2	2	3	H		
9092103	15	1	6/7/2010	1	1	2	H		
9092103	15	2	6/7/2010	2	2	2	H		
9092103	15	3	6/7/2010	2	1	2	H	diseased	
9092103	27	1	6/7/2010	1	1	2	H		
9092103	27	2	6/7/2010	1	1	1	H		
9092103	27	3	6/7/2010	1	2	2	H		
9092104	5	1	6/7/2010	1	2	2	H		
9092104	5	3	6/7/2010	2	2	1	H		
9092104	15	1	6/7/2010	2	2	1	H		
9092104	15	2	6/7/2010	2	1	1	H		
9092104	15	3	6/7/2010	2	2	1	H		
9092104	29	1	6/7/2010	2	1	2	H		
9092104	29	2	6/7/2010	1	1	1	H		forage
9092104	29	3	6/7/2010	1	1	1	H		
9092105	3	2	6/7/2010	3	3	3	H		
9092105	3	3	6/7/2010	2	1	2	H		
9092105	16	1	6/7/2010	2	2	2	H		
9092105	16	2	6/7/2010	2	2	2	H		
9092105	16	3	6/7/2010	2	2	2	H		

Accession	Row	Plant	Date	* rating Height	** rating Culms	*** rating Leafiness	**** Maturity	Remarks	2011 Selection
9092105	25	1	6/7/2010	1	2	2	H		
9092105	25	2	6/7/2010	1	2	2	H		
9092105	25	3	6/7/2010	1	1	2	H		
9092106	3	1	6/7/2010	2	3	3	H		
9092106	3	3	6/7/2010	2	2	2	H		
9092106	16	1	6/7/2010	2	2	2	H		
9092106	16	2	6/7/2010	2	2	2	H		
9092106	16	3	6/7/2010	2	2	2	H		
9092106	23	1	6/7/2010	2	1	2	H		
9092106	23	2	6/7/2010	2	3	3	H		
9092106	23	3	6/7/2010	2	2	2	H		
9092107	5	1	6/7/2010	1	1	2	H		
9092107	5	2	6/7/2010	1	2	2	H		
9092107	5	3	6/7/2010	1	1	1	H	diseased	
9092107	16	1	6/7/2010	2	2	2	H		
9092107	16	2	6/7/2010	2	2	1	H		
9092107	16	3	6/7/2010	2	2	2	H		
9092107	28	1	6/7/2010	1	2	1	H		
9092107	28	3	6/7/2010	2	1	2	H		
9092108	5	1	6/7/2010	1	2	2	H		
9092108	5	2	6/7/2010	1	1	2	H		
9092108	5	3	6/7/2010	1	1	1	H		turf
9092108	16	1	6/7/2010	2	2	2	H		
9092108	16	2	6/7/2010	2	1	2	H		
9092108	25	1	6/7/2010	1	1	2	H		
9092108	25	2	6/7/2010	1	2	2	H		
9092108	25	3	6/7/2010	2	2	2	H		
9092109	5	1	6/7/2010	1	2	2	H		forage
9092109	5	2	6/7/2010	2	2	2	H	insects	
9092109	5	3	6/7/2010	1	2	2	H		
9092109	16	1	6/7/2010	1	2	1	H		
9092109	16	2	6/7/2010	1	1	2	H		
9092109	16	3	6/7/2010	2	1	1	H		
9092109	27	1	6/7/2010	1	1	1	H		forage
9092109	27	2	6/7/2010	1	1	2	H		
9092109	27	3	6/7/2010	1	1	2	H		
9092110	5	1	6/7/2010	2	3	3	H	partially dead	
9092110	5	2	6/7/2010	2	2	2	H		
9092110	5	3	6/7/2010	0	0	0	X		
9092110	17	1	6/7/2010	2	2	2	H		
9092110	17	2	6/7/2010	1	1	2	H		
9092110	17	3	6/7/2010	1	1	2	H		
9092110	30	2	6/7/2010	2	2	3	H		
9092110	30	3	6/7/2010	2	1	2	H		
9092111	2	1	6/7/2010	1	3	3	H		

Accession	Row	Plant	Date	* rating Height	** rating Culms	*** rating Leafiness	**** Maturity	Remarks	2011 Selection
9092111	2	3	6/7/2010	2	1	1	H	diseased	
9092111	17	1	6/7/2010	2	2	3	H		
9092111	17	2	6/7/2010	2	1	1	H	Insects	
9092111	17	3	6/7/2010	2	2	3	H		
9092111	30	1	6/7/2010	2	2	2	H		
9092111	30	2	6/7/2010	1	2	2	H		
9092111	30	3	6/7/2010	1	1	2	H		
9092112	7	2	6/7/2010	2	3	3	H		
9092112	19	1	6/7/2010	2	2	3	H		
9092112	19	2	6/7/2010	2	2	2	H		
9092112	19	3	6/7/2010	2	2	2	H		
9092112	22	1	6/7/2010	1	1	2	H		
9092112	22	2	6/7/2010	3	3	3	H	partially dead	
9092113	10	1	6/7/2010	2	2	2	H		
9092113	10	2	6/7/2010	2	1	1	A		
9092113	10	3	6/7/2010	3	3	3	A		
9092113	19	1	6/7/2010	2	2	2	H		
9092113	19	2	6/7/2010	2	2	2	H		
9092113	29	1	6/7/2010	1	1	1	H		
9092113	29	2	6/7/2010	1	1	1	H		
9092114	10	1	6/7/2010	2	3	2	H		
9092114	10	3	6/7/2010	2	1	1	H		forage
9092114	18	1	6/7/2010	1	1	2	H		
9092114	18	2	6/7/2010	2	2	2	H		
9092114	18	3	6/7/2010	2	1	1	H		forage
9092114	31	1	6/7/2010	1	1	1	H		
9092114	31	2	6/7/2010	1	1	2	H		
9092114	31	3	6/7/2010	1	1	1	H		
9092115	10	1	6/7/2010	2	2	2	H		
9092115	10	2	6/7/2010	2	1	2	H		
9092115	10	3	6/7/2010	2	1	2	H		
9092115	18	1	6/7/2010	1	2	2	H		
9092115	18	3	6/7/2010	2	3	3	H		
9092115	30	1	6/7/2010	2	2	2	H		
9092115	30	2	6/7/2010	1	1	1	H		
9092115	30	3	6/7/2010	2	1	1	H		
9092116	10	1	6/7/2010	1	1	1	H		
9092116	10	2	6/7/2010	1	1	2	H		
9092116	10	3	6/7/2010	2	2	2	H		
9092116	20	1	6/7/2010	1	2	1	H	turf type	
9092116	20	2	6/7/2010	2	1	1	H		
9092116	20	3	6/7/2010	2	1	1	H		
9092116	27	3	6/7/2010	1	1	3	H		
9092117	10	1	6/7/2010	1	1	2	H		
9092117	10	2	6/7/2010	2	2	2	H	diseased	

Accession	Row	Plant	Date	* rating Height	** rating Culms	*** rating Leafiness	**** Maturity	Remarks	2011 Selection
9092117	10	3	6/7/2010	2	2	2	H		
9092117	20	1	6/7/2010	2	2	2	H		
9092117	20	3	6/7/2010	1	2	2	H		
9092117	24	1	6/7/2010	2	2	2	H		
9092117	24	2	6/7/2010	1	1	2	H		
9092117	24	3	6/7/2010	3	2	2	H		
9092118	9	1	6/7/2010	2	3	3	H		
9092118	9	2	6/7/2010	2	1	1	H		turf
9092118	9	3	6/7/2010	1	2	2	H		
9092118	20	1	6/7/2010	1	1	2	H		forage
9092118	20	2	6/7/2010	1	2	1	H		
9092118	20	3	6/7/2010	2	3	2	H		
9092118	26	1	6/7/2010	1	2	2	H		
9092118	26	2	6/7/2010	1	1	1	H		
9092118	26	3	6/7/2010	2	2	2	H		
9092119	6	2	6/7/2010	2	1	2	H		
9092119	6	3	6/7/2010	2	2	2	H		
9092119	19	1	6/7/2010	2	2	2	H		
9092119	19	2	6/7/2010	1	2	1	H		
9092119	19	3	6/7/2010	1	1	2	H		
9092119	24	1	6/7/2010	1	1	1	H		
9092119	24	2	6/7/2010	1	2	2	H		
9092119	24	3	6/7/2010	1	1	1	H		
9092120	4	1	6/7/2010	2	2	2	H		
9092120	4	2	6/7/2010	2	2	2	H		
9092120	4	3	6/7/2010	2	3	3	H		
9092120	19	1	6/7/2010	2	1	2	H		
9092120	19	2	6/7/2010	2	1	1	H		
9092120	19	3	6/7/2010	2	2	3	H	diseased	
9092120	26	1	6/7/2010	3	3	2	H		
9092120	26	2	6/7/2010	1	1	2	H		
9092120	26	3	6/7/2010	2	1	2	H		
9092121	19	1	6/7/2010	2	2	1	H		forage
9092121	19	2	6/7/2010	2	2	2	H		
9092121	19	3	6/7/2010	2	2	2	H	Insects	
9092121	23	1	6/7/2010	2	3	3	H		
9092121	23	2	6/7/2010	2	2	3	H		
9092121	23	3	6/7/2010	2	3	3	H		
9092123	11	1	6/7/2010	2	2	2	H		
9092123	11	2	6/7/2010	2	2	2	H		
9092123	11	3	6/7/2010	2	2	2	H		
9092123	15	1	6/7/2010	2	2	2	H		turf
9092124	7	1	6/7/2010	2	2	3	H		
9092124	7	3	6/7/2010	2	3	3	H		
9092124	15	1	6/7/2010	1	2	2	H		

Accession	Row	Plant	Date	* rating Height	** rating Culms	*** rating Leafiness	**** Maturity	Remarks	2011 Selection
9092124	15	2	6/7/2010	1	2	2	H		
9092124	15	3	6/7/2010	2	2	2	H		
9092124	31	2	6/7/2010	2	3	3	H		
9092124	31	3	6/7/2010	1	1	2	H		
9092125	5	1	6/7/2010	1	2	2	H		
9092125	5	2	6/7/2010	1	2	1	H		
9092125	5	3	6/7/2010	1	1	1	H		
9092125	15	1	6/7/2010	3	2	3	H		
9092125	15	2	6/7/2010	1	2	2	H		
9092125	15	3	6/7/2010	3	3	3	H		
9092125	31	1	6/7/2010	1	2	3	H		
9092125	31	2	6/7/2010	2	2	1	H		
9092125	31	3	6/7/2010	2	2	2	H		
9092126	3	1	6/7/2010	2	1	2	H		
9092126	3	2	6/7/2010	3	3	3	H		
9092126	15	1	6/7/2010	2	2	1	H		
9092126	15	3	6/7/2010	2	2	2	H		
9092126	30	1	6/7/2010	2	1	2	H		
9092126	30	2	6/7/2010	2	2	2	H		
9092126	30	3	6/7/2010	1	1	2	H		
9092133	1	1	6/7/2010	3	3	3	H	almost dead	
9092133	1	3	6/7/2010	2	2	2	H		
9092133	11	1	6/7/2010	2	1	1	H		
9092133	11	2	6/7/2010	1	1	1	H	nice plant	turf
9092133	11	3	6/7/2010	2	2	1	H		turf
9092133	25	1	6/7/2010	2	1	3	H		
9092134	1	2	6/7/2010	3	3	3	H		
9092134	11	1	6/7/2010	2	3	3	H		
9092134	11	2	6/7/2010	0	0	0	X		
9092134	11	3	6/7/2010	3	2	2	H		
9092134	23	1	6/7/2010	1	2	2	H		
9092135	1	2	6/7/2010	1	1	1	H		turf
9092135	1	3	6/7/2010	1	2	2	H		
9092135	11	2	6/7/2010	1	1	1	H	partially dead	
9092135	11	3	6/7/2010	2	1	2	H		
9092135	28	1	6/7/2010	1	1	1	H		
9092135	28	2	6/7/2010	1	2	2	H		
9092136	1	1	6/7/2010	2	3	2	H		
9092136	1	3	6/7/2010	2	3	3	H		
9092136	12	1	6/7/2010	2	2	2	H		
9092136	12	2	6/7/2010	2	1	2	H		
9092136	12	3	6/7/2010	3	3	3	H	almost dead	
9092136	22	1	6/7/2010	2	2	2	H		
9092136	22	2	6/7/2010	3	3	2	H		
9092136	22	3	6/7/2010	3	2	2	H		

Accession	Row	Plant	Date	* rating Height	** rating Culms	*** rating Leafiness	**** Maturity	Remarks	2011 Selection
9092177	9	1	6/7/2010	2	2	2	H		
9092177	9	2	6/7/2010	1	2	2	H		
9092177	9	3	6/7/2010	2	2	2	H		
9092177	12	1	6/7/2010	1	1	1	H		
9092177	12	2	6/7/2010	1	2	1	H		forage
9092177	12	3	6/7/2010	2	2	2	H		
9092177	24	1	6/7/2010	1	2	2	H		forage
9092177	24	2	6/7/2010	2	3	3	H		
9092177	24	3	6/7/2010	1	1	1	H		
9092178	9	1	6/7/2010	2	2	1	H		
9092178	9	2	6/7/2010	2	2	2	H		
9092178	9	3	6/7/2010	2	2	2	H	thrips	
9092178	11	1	6/7/2010	1	2	2	H		
9092178	11	2	6/7/2010	1	2	2	H		
9092178	11	3	6/7/2010	2	2	2	H		
9092178	28	1	6/7/2010	1	1	2	H		
9092178	28	2	6/7/2010	1	2	2	H		
9092178	28	3	6/7/2010	1	2	2	H		
9092179	10	1	6/7/2010	2	2	2	H		
9092179	10	2	6/7/2010	2	2	2	H	diseased	
9092179	10	3	6/7/2010	2	2	3	H	diseased	
9092179	12	1	6/7/2010	2	1	2	H		
9092179	12	2	6/7/2010	2	1	1	H	diseased	
9092179	29	1	6/7/2010	1	1	1	H		
9092179	29	2	6/7/2010	1	2	2	H		
9092179	29	3	6/7/2010	2	2	2	H		
9092180	3	2	6/7/2010	2	2	2	H		
9092180	3	3	6/7/2010	3	3	3	H		
9092180	16	1	6/7/2010	2	2	2	H		
9092180	16	2	6/7/2010	1	1	1	H		forage
9092180	16	3	6/7/2010	2	3	3	H		
9092180	27	1	6/7/2010	2	2	2	H		
9092180	27	2	6/7/2010	2	2	3	H		
9092180	27	3	6/7/2010	3	3	3	H		
9092181	8	1	6/7/2010	3	3	3	H		
9092181	8	2	6/7/2010	1	1	2	H	nice plant	
9092181	8	3	6/7/2010	2	2	2	H		
9092181	16	1	6/7/2010	3	2	3	H		
9092181	16	2	6/7/2010	1	1	2	H		
9092181	16	3	6/7/2010	2	2	3	H		
9092181	31	1	6/7/2010	1	1	2	H		
9092182	2	1	6/7/2010	1	2	2	A		
9092182	16	1	6/7/2010	1	1	1	H	nice plant	
9092182	16	3	6/7/2010	1	1	1	H		
9092182	22	1	6/7/2010	1	1	2	A		

Accession	Row	Plant	Date	* rating Height	** rating Culms	*** rating Leafiness	**** Maturity	Remarks	2011 Selection
9092182	22	2	6/7/2010	1	1	1	A		
9092182	22	3	6/7/2010	1	1	1	A		
9092183	4	1	6/7/2010	3	2	2	A		turf
9092183	4	3	6/7/2010	2	2	3	A		
9092183	20	1	6/7/2010	1	1	2	H	Insects	
9092183	20	2	6/7/2010	2	2	2	H		
9092183	31	1	6/7/2010	2	2	2	H		
9092183	31	2	6/7/2010	1	1	2	A		
9092184	7	1	6/7/2010	1	1	1	H		
9092184	7	3	6/7/2010	1	1	1	A		
9092184	20	2	6/7/2010	1	2	1	A		
9092184	20	3	6/7/2010	1	2	2	H		
9092184	28	2	6/7/2010	1	1	2	A		
9092185	6	1	6/7/2010	2	1	2	H		
9092185	6	2	6/7/2010	1	1	2	H		
9092185	6	3	6/7/2010	3	2	2	H		
9092185	20	1	6/7/2010	3	2	1	H		
9092185	20	2	6/7/2010	2	1	2	H	Insects	
9092185	20	3	6/7/2010	3	3	2	A		
9092185	28	1	6/7/2010	2	2	2	A		
9092185	28	2	6/7/2010	1	1	1	A		
9092185	28	3	6/7/2010	1	2	2	A		
9092186	9	3	6/7/2010	1	1	1	H	thrips	
9092186	20	1	6/7/2010	1	3	3	H		
9092186	20	3	6/7/2010	1	1	1	H		
9092186	22	1	6/7/2010	1	1	2	H		
9092186	22	2	6/7/2010	1	1	1	H		
9092186	22	3	6/7/2010	1	1	1	H		
9092187	8	1	6/7/2010	2	1	2	H		
9092187	8	2	6/7/2010	2	1	1	H		
9092187	8	3	6/7/2010	2	1	1	H	thrips	
9092187	18	1	6/7/2010	2	2	2	H		
9092187	18	2	6/7/2010	2	2	2	H		
9092187	18	3	6/7/2010	1	1	2	H		forage
9092187	25	1	6/7/2010	1	1	1	H		
9092187	25	2	6/7/2010	1	1	2	H		
9092187	25	3	6/7/2010	2	2	2	H		
9092188	8	1	6/7/2010	2	1	1	H		
9092188	8	3	6/7/2010	2	1	1	H	fine heads	
9092188	18	1	6/7/2010	2	1	1	B		
9092188	18	2	6/7/2010	3	1	2	H		
9092188	18	3	6/7/2010	2	2	3	H		
9092188	26	1	6/7/2010	3	2	1	H		
9092189	18	1	6/7/2010	3	1	1	H		turf
9092189	18	2	6/7/2010	3	2	2	H		

Accession	Row	Plant	Date	* rating Height	** rating Culms	*** rating Leafiness	**** Maturity	Remarks	2011 Selection
9092189	18	3	6/7/2010	2	2	1	H		
9092189	25	1	6/7/2010	2	2	2	H		
9092189	25	2	6/7/2010	2	2	2	H		
9092189	25	3	6/7/2010	3	3	3	H		
9092190	4	1	6/7/2010	2	3	3	H		
9092190	4	2	6/7/2010	3	3	3	A		
9092190	18	1	6/7/2010	1	2	2	H		
9092190	18	2	6/7/2010	2	2	2	H		
9092190	18	3	6/7/2010	2	2	3	H		
9092190	21	1	6/7/2010	2	1	1	H		
9092190	21	2	6/7/2010	3	2	3	H	Insects	
9092190	21	3	6/7/2010	2	2	3	H		
9092191	1	1	6/7/2010	1	3	3	A		
9092191	1	2	6/7/2010	1	1	2	H		
9092191	18	1	6/7/2010	1	2	2	H		
9092191	18	2	6/7/2010	1	2	2	H		
9092191	18	3	6/7/2010	1	2	1	H		
9092191	24	1	6/7/2010	1	2	2	A		
9092191	24	2	6/7/2010	2	2	2	H		
9092191	24	3	6/7/2010	2	1	2	H		
9092192	3	1	6/7/2010	1	2	2	H		
9092192	17	1	6/7/2010	2	2	3	H		
9092192	17	2	6/7/2010	2	2	3	H		
9092192	17	3	6/7/2010	2	1	1	H		
9092192	30	1	6/7/2010	1	1	1	H		forage
9092192	30	2	6/7/2010	2	2	2	H		
9092192	30	3	6/7/2010	1	1	1	H		
9092193	2	3	6/7/2010	1	2	2	H		
9092193	17	1	6/7/2010	3	2	2	H		
9092193	17	2	6/7/2010	3	2	2	H	Insects	
9092193	17	3	6/7/2010	2	2	2	H		
9092193	29	1	6/7/2010	1	2	1	H		
9092193	29	2	6/7/2010	2	1	1	H		
9092193	29	3	6/7/2010	2	1	2	H		
9092194	5	1	6/7/2010	2	1	2	H		
9092194	5	2	6/7/2010	2	2	1	H		
9092194	5	3	6/7/2010	2	2	3	H		
9092194	16	1	6/7/2010	3	2	2	H		
9092194	16	2	6/7/2010	3	2	1	H		
9092194	16	3	6/7/2010	1	1	1	H		
9092194	25	1	6/7/2010	1	1	1	H		turf
9092194	25	2	6/7/2010	1	1	1	H		forage
9092194	25	3	6/7/2010	2	1	1	H		
9092195	6	1	6/7/2010	1	2	2	H		
9092195	6	2	6/7/2010	3	3	3	H		

Accession	Row	Plant	Date	* rating Height	** rating Culms	*** rating Leafiness	**** Maturity	Remarks	2011 Selection
9092195	6	3	6/7/2010	2	1	1	H	upright, nice plant	
9092195	15	1	6/7/2010	1	1	1	H	thrips	forage
9092195	15	2	6/7/2010	3	2	2	H		
9092195	15	3	6/7/2010	2	2	2	H		
9092195	22	1	6/7/2010	2	1	1	H		
9092195	22	2	6/7/2010	1	2	1	H	very leafy	
9092195	22	3	6/7/2010	2	1	1	H		
9092196	7	1	6/7/2010	1	2	2	H		
9092196	7	2	6/7/2010	3	3	2	H		
9092196	7	3	6/7/2010	2	2	1	H		
9092196	15	1	6/7/2010	2	2	2	H		turf
9092196	15	2	6/7/2010	2	1	2	H		
9092196	15	3	6/7/2010	2	2	2	H		
9092196	30	1	6/7/2010	2	2	2	H		
9092196	30	2	6/7/2010	2	1	1	H		
9092196	30	3	6/7/2010	1	1	2	H		
9092197	8	1	6/7/2010	2	3	3	H		
9092197	8	3	6/7/2010	1	1	1	H		forage
9092197	15	1	6/7/2010	2	2	1	H		
9092197	15	2	6/7/2010	2	1	1	H		
9092197	15	3	6/7/2010	2	1	2	H		
9092197	24	1	6/7/2010	1	1	2	H		
9092197	24	2	6/7/2010	2	2	2	H		
9092197	24	3	6/7/2010	1	1	1	H		
9092198	9	1	6/7/2010	2	2	2	H		
9092198	9	2	6/7/2010	1	2	2	H		
9092198	21	1	6/7/2010	2	2	2	H		
9092198	21	2	6/7/2010	2	2	3	H		
9092198	21	3	6/7/2010	2	1	1	H		
9092198	28	1	6/7/2010	2	2	1	H		
9092198	28	2	6/7/2010	2	2	1	H		
9092198	28	3	6/7/2010	2	2	2	H		
9092199	9	1	6/7/2010	1	1	1	H		forage
9092199	9	2	6/7/2010	1	1	1	H		turf
9092199	9	3	6/7/2010	2	1	1	H		
9092199	21	1	6/7/2010	1	2	1	H	Insects	
9092199	21	2	6/7/2010	2	2	2	H		
9092199	23	1	6/7/2010	3	3	2	H		
9092199	23	2	6/7/2010	2	1	2	H		
9092199	23	3	6/7/2010	1	1	2	H		
9092200	9	1	6/7/2010	2	2	2	H		
9092200	9	2	6/7/2010	3	3	3	H		
9092200	9	3	6/7/2010	1	2	2	H		
9092200	21	1	6/7/2010	2	1	2	H		turf
9092200	21	2	6/7/2010	2	2	1	H		

Accession	Row	Plant	Date	* rating Height	** rating Culms	*** rating Leafiness	**** Maturity	Remarks	2011 Selection
9092200	21	3	6/7/2010	2	2	2	H		
9092200	26	1	6/7/2010	1	1	1	H		forage
9092200	26	2	6/7/2010	2	1	2	H		
9092200	26	3	6/7/2010	2	2	1	H		
9092201	10	1	6/7/2010	3	1	2	H		
9092201	10	2	6/7/2010	2	2	2	H		
9092201	10	3	6/7/2010	3	1	1	H	turf type	turf
9092201	12	1	6/7/2010	2	2	3	H		
9092201	12	2	6/7/2010	2	1	1	H		
9092201	12	3	6/7/2010	2	1	1	H	turf type	turf
9092201	26	1	6/7/2010	2	2	2	H		
9092201	26	2	6/7/2010	1	1	1	H		
9092202	11	1	6/7/2010	1	2	1	H		
9092202	11	2	6/7/2010	2	3	3	H	Insects	
9092202	11	3	6/7/2010	2	1	2	H	diseased	
9092202	12	1	6/7/2010	1	1	2	H		
9092202	12	2	6/7/2010	1	2	2	H		
9092202	12	3	6/7/2010	1	2	3	H		
9092202	27	1	6/7/2010	2	2	2	H		
9092202	27	2	6/7/2010	2	2	2	H		
9092202	27	3	6/7/2010	2	1	1	H		
9092203	11	1	6/7/2010	2	2	3	H		
9092203	11	2	6/7/2010	1	2	2	H	Insects	
9092203	11	3	6/7/2010	2	2	2	H		
9092203	12	1	6/7/2010	2	2	2	H		
9092203	12	2	6/7/2010	3	3	3	H	almost dead	
9092203	12	3	6/7/2010	1	2	2	H		
9092203	30	1	6/7/2010	1	1	1	H		
9092203	30	2	6/7/2010	2	1	1	H		
9092203	30	3	6/7/2010	2	1	2	H		
9092204	11	1	6/7/2010	2	1	1	H		
9092204	11	2	6/7/2010	2	2	2	H		
9092204	11	3	6/7/2010	2	1	1	H		
9092204	12	2	6/7/2010	2	3	2	H		
9092204	12	3	6/7/2010	2	1	1	H		forage
9092204	31	1	6/7/2010	2	2	2	H		
9092205	10	1	6/7/2010	2	2	1	H		
9092205	10	2	6/7/2010	2	1	1	H		
9092205	10	3	6/7/2010	2	2	2	H		
9092205	12	1	6/7/2010	2	2	3	H		
9092205	12	2	6/7/2010	1	2	1	H		
9092205	12	3	6/7/2010	1	1	1	H	turf type	
9092205	23	1	6/7/2010	1	1	1	H		
9092205	23	3	6/7/2010	1	1	1	H		
9092206	10	1	6/7/2010	2	2	2	H		

Accession	Row	Plant	Date	* rating Height	** rating Culms	*** rating Leafiness	**** Maturity	Remarks	2011 Selection
9092206	10	2	6/7/2010	1	1	1	H	upright	
9092206	10	3	6/7/2010	2	2	1	H		
9092206	12	1	6/7/2010	2	2	2	H	Insects	
9092206	12	2	6/7/2010	1	2	1	H		
9092206	12	3	6/7/2010	2	1	1	H	Insects	
9092206	27	1	6/7/2010	3	3	3	V		
9092206	27	2	6/7/2010	2	2	2	A		
9092206	27	3	6/7/2010	3	3	3	H		
9092207	7	1	6/7/2010	2	3	3	H		
9092207	7	2	6/7/2010	1	1	2	A		
9092207	7	3	6/7/2010	2	2	2	H		
9092207	13	1	6/7/2010	1	2	2	H		
9092207	13	2	6/7/2010	2	1	2	H		
9092207	13	3	6/7/2010	2	2	2	H		
9092207	29	1	6/7/2010	2	2	2	H		
9092207	29	2	6/7/2010	1	2	2	H		
9092207	29	3	6/7/2010	2	2	2	H		
9092208	4	1	6/7/2010	2	2	2	H		
9092208	4	2	6/7/2010	2	2	1	B		
9092208	13	1	6/7/2010	2	2	2	H		
9092208	13	2	6/7/2010	1	2	2	H		
9092208	13	3	6/7/2010	2	1	1	H		
9092208	24	1	6/7/2010	2	2	3	H		
9092208	24	2	6/7/2010	2	2	1	H		
9092208	24	3	6/7/2010	2	2	1	H		
9092209	2	1	6/7/2010	2	2	1	H		
9092209	2	2	6/7/2010	2	3	3	H		
9092209	2	3	6/7/2010	2	1	2	H	diseased	
9092209	13	1	6/7/2010	2	2	1	H		
9092209	13	2	6/7/2010	2	2	2	H		
9092209	13	3	6/7/2010	1	1	1	H		
9092209	26	1	6/7/2010	2	2	1	H		
9092209	26	2	6/7/2010	1	2	2	H		
9092210	1	1	6/7/2010	2	3	3	H		
9092210	1	2	6/7/2010	1	1	2	H	upright	
9092210	1	3	6/7/2010	3	2	2	H		
9092210	13	2	6/7/2010	2	3	2	H	leaf disease	
9092210	13	3	6/7/2010	3	2	1	H	Insects	
9092210	29	1	6/7/2010	2	2	3	H		
9092210	29	2	6/7/2010	2	1	2	H		
9092211	9	1	6/7/2010	1	2	2	A		
9092211	9	3	6/7/2010	1	1	1	A		
9092211	14	1	6/7/2010	2	1	2	A		
9092211	14	2	6/7/2010	1	2	2	A		
9092211	23	1	6/7/2010	3	2	2	A		

Accession	Row	Plant	Date	* rating Height	** rating Culms	*** rating Leafiness	**** Maturity	Remarks	2011 Selection
9092211	23	2	6/7/2010	1	1	2	A		
9092211	23	3	6/7/2010	1	1	1	A		
9092214	3	1	6/7/2010	3	3	3	H		
9092214	3	2	6/7/2010	2	2	2	H		
9092214	3	3	6/7/2010	1	1	1	H		
9092214	11	1	6/7/2010	0	0	0	X		
9092214	11	2	6/7/2010	2	2	3	H		
9092214	11	3	6/7/2010	3	2	2	H		
9092214	24	1	6/7/2010	1	1	1	H		
9092214	24	2	6/7/2010	2	1	2	H		
9092214	24	3	6/7/2010	1	2	2	H		
9092225	9	1	6/7/2010	2	2	2	H		
9092225	9	2	6/7/2010	2	2	2	H		
9092225	9	3	6/7/2010	3	3	3	H		
9092225	14	1	6/7/2010	3	1	2	H		
9092225	14	2	6/7/2010	2	1	1	H		turf
9092225	14	3	6/7/2010	2	2	2	H		
9092225	25	1	6/7/2010	2	2	2	H		
9092225	25	2	6/7/2010	2	1	1	H		
9092225	25	3	6/7/2010	1	2	1	H		turf

ACTIVE STUDIES: TECHNICAL REPORT 2010-2012

Study NDPMC-P-0601-RA

Study Title: Native Forbs/Legumes for Conservation
Fourwing saltbush *Atriplex canescens*

Introduction: Fourwing saltbush is a perennial shrub that offers potential for conservation plantings. It grows under low rainfall, can tolerate alkaline and saline conditions, and is palatable and nutritious to most livestock.

Objective: The purpose of our study is to evaluate adaptability and produce seed of this species. A South Dakota collection of this species will be evaluated. If the species proves adaptable and useful as a conservation plant, a public release will be the goal.

Cooperators: USDA, NRCS Plant Materials Center, Bismarck, North Dakota
USDA, ARS Northern Great Plains Research Service, Mandan, North Dakota

Description: Fourwing saltbush is a long-lived perennial shrub. It has a deep, extensive root system. It is an evergreen gray shrub that grows from 2-6 feet tall. It has many branches. Leaves are alternate, and narrowly oblong. Leaves are scurfy on both sides. Male and female flowers are on separate plants. Flowers are in spikes that form dense panicles. It blooms in late summer. Fruiting bracts have four flat wings from which the plant gets its name. It is palatable to browse and grazing animals. Other common names include fourwing shadscale, white greasewood, salt sage, box brush. Fourwing saltbush differs from Nuttall saltbush. Its most noticeable difference is its four wings on the fruit, as opposed to the warty bracts enclosing the fruit of Nuttall saltbush.

Distribution: Fourwing grows on a wide range of soils, from clays to sands, and can tolerate high lime and saline conditions. It is highly drought and heat tolerant. It is native from western North Dakota south to Texas and Mexico, and west to Washington.

Methods and Materials

The study is divided into four parts. These will be listed as Field Trial - PMC, Source Comparison Trial, Field Planting - Golden Valley County, and Lincoln-Oakes Nursery Trial. The primary seed source being evaluated is accession 9082680 from South Dakota

Seed Sources:

Accession 9082680 is an *Atriplex canescens*. Seed was collected from several plants at the SDSU Cottonwood Range and Livestock Research Center in Jackson County, South Dakota, by Ron Haigh in 1999. The collection site is in Major Land Resource Area 060A Pierre Shale Plains and Badlands. Its legal description is SE $\frac{1}{4}$ SW $\frac{1}{4}$ Sec.16-T1S-R19E. Its latitude is 43°56'57" N and the longitude is 101°51'30" W. The seed was collected in an enclosure area that excluded cattle and wildlife. No other plants of the species are growing in the nearby vicinity except adjacent to the enclosure. These plants are grazed each year, and appear to have abundant regrowth each spring, according to Ron Haigh. A small envelope of seed was given to the PMC in 2000 by Scot Kronberg, USDA, ARS, Mandan, North Dakota. Seed was propagated in the greenhouse for the Field Trial - PMC and Source Comparison Trial. Seed produced from this accession in the Field Trial - PMC was distributed for Field Planting - Golden Valley County and to Lincoln-Oakes Nursery Trial.

Accession 9082855 Natrona is an *Atriplex canescens* selection from Wind River Seed Company, Manderson, WY. Seed was propagated in the greenhouse for a Source Comparison Trial. Seed was distributed for Field Planting - Golden Valley County.

Accession 346419 Wytana is an *Atriplex aptera* release from the Bridger, Montana PMC. Seed was propagated in the greenhouse for the Source Comparison Trial.

Propagation in the greenhouse was in cone-tainers™, using a soilless potting mix. Seed germinated with no pretreatment. Seedlings of all accessions were vigorous and growth was abundant. Plants were hardened off in a lath house prior to planting in the field.

See sections below for information related to each type of trial or planting.

1. Field Trial - PMC

This is located in Panel D10 inside deer fence: Seedlings (25-27) were planted from east to west in a single row on 5/24/2001. The plants were spaced approximately 2 feet apart. Conditions at the time of planting were dry. An additional 4 rows were planted on June 5, 2003, to the north of the 2001 planting. Spacing between the rows was approximately 7 feet. The field was relatively free of growing weeds at the time of planting.

Maintenance:

Weed Control: Hand weeding was done around plants. Thistles were spot sprayed and borders were sprayed with glyphosate. Spraying and mowing between rows has been used to control weeds since 2004. Primary weeds have been kochia, pigweed, lambsquarters, foxtail and some Canada thistle..

Residue Management: No residue was clipped after harvest in 2001, 2002, 2003, 2005, or 2007. Residue was clipped to a 4-8 inch height in November after harvest in 2004, 2006, 2008, 2009, and 2011. Residue from 2007 was clipped in early spring of 2008. After harvest in 2008, residue for the three north rows was clipped. The residue from 2010 was not clipped, and plants remained standing.

Seed Harvest:

Seed has been hand harvested from 2002-2012. Seed was harvested 10/24/2002 and in mid-October through November for all other years. Seed was harvested from a single 50-foot row in 2002 and 2003 and from all rows in 2004-2012.

Seed Cleaning:

2002: Pan screens, a hammer mill with the largest hole screen and a clipper office sized fanning mill with a blank screen on the bottom, 25/64 to 28/64 size screens on top.

2003: Office-sized debearder equipped with rubber corrugation covering the inside, and pan screens.

2004-2012: Debearder and fanning mill.

Evaluation:

Visual observations have been made on plant growth. Seed production has been recorded each year (Table FW-1) and forage quality was tested in 2002 (Table FW-2).

Forage Quality: Forage samples were collected for analysis on 11/6/2002. The tips of top and side branches were clipped on randomly selected plants. The length of the samples averaged 12-15 inches. The samples were then cut into two sections. The top 6 inches, including stem and leaf, were cut and bulked as a sample named TIPS6. Leaves were stripped from the lower remaining 6-9 inches of the original sample and named LF12. Samples were analyzed for ADF, NDF, and Crude Protein by Oscar E. Olson Biochemistry Laboratories at South Dakota State University.

2. Source Comparison Trial

A small trial to compare performance of different sources of fourwing saltbush was planted 6/12/2003. Five plants each of three accessions were planted on the north end of panel A in the previous IEP area. Seedlings were grown in the greenhouse and planted to the field on 6/12/2003. Row spacing was 6-7 feet apart. Spacing between plants in the row was approximately 4 feet. Accessions compared were 9082680 (South Dakota), Natrona (Wyoming) and Wytana (Montana). The southernmost row is the Wyoming source, the center row is the South Dakota source, and the northernmost row is Wytana. Size data was collected on growth of each of the sources on 9/24/2003 and on 9/8/2004 (Table FW-3). The trial was removed in 2009.

3. Field Planting NDPMS-F-0808-RA - Golden Valley County; Cooperator: Scot Steele

Seed of 9082680 harvested from the Field Trial - PMC and Natrona, purchased from Wind River Seed, were distributed to the Beach, North Dakota, NRCS Field Office for a field planting trial. The Field Planting Number is NDPMS-F-0808-RA. It was seeded with a drill on 5/13/2008 as 20 percent of a range seeding mix in Golden Valley County. Each accession was seeded on 4-5 acres of the total seeding area. Data collection began in the fall of 2008 and will continue for 3-5 years.

4. Lincoln – Oakes Nursery Trial

Approximately 1.8 PLS pounds (3 bulk pounds) of 9082680 produced from the Field Trial - PMC was distributed to Lincoln-Oakes Nursery for production of seedlings. Seed was planted in late fall of 2008 in a field bed. The seeding failed to produce a stand.

Results and Discussion

1. Field Trial - PMC

Plants in the field were vigorous and were 2-3 feet tall on 9/30/2001. Conditions were dry during the growing season of 2001. No seed was produced the first year of growth. Plants were vigorous in 2002. Height on 8/13/2002 averaged 40 inches for the leafy plants which are males. The females which make up about 1/3 of the plants were extremely heavy with seed pods and reached a height of 30 inches. The seed covering had a green tint at harvest, which was after a hard frost. Conditions in 2003 were very dry, but plants were again quite vigorous. Seedlings planted to extend the field in 2003 were not harvested in 2003. Seed production in 2005 was very poor. Plant residue had been clipped in 2004. The plants were large and woody at the time. It appears that the older the plant when residue is removed, the slower the regrowth. Seed production in 2006 was good and poor in 2007. Plants thought to be females in 2006 were flagged. Some of the flagged plants did not produce seed in 2007. It is not known if they produced pollen as a male plant instead, or if seed set was just poor. Seed production was good in 2008. Plants that did not have the 2007 residue removed produced seed, but were difficult to harvest. Seed production in 2009 was very good and plants were vigorous. Harvests in 2011 and 2012 were fair. Fewer plants remain in the trial. Gophers and herbicide may have contributed to plants dying. Clipping residue every year or every other year produced the greatest seed harvests. Plants were less woody with only one year of growth. Table FW-1 lists amount of seed harvested each year. Currently, no mechanical harvest method has been found. This is the greatest challenge in seed production.

2. Source Comparison Trial

Data collected on 9/24/2003 indicated differences in growth form among the three accessions (see Table FW-3). Overall, plants of Wyoming origin (9082855) were more upright and had less lateral spread and branching than the South Dakota source (9082680). Wytana was not vigorous and showed little growth in 2003. Plants continued to display these growth habits from 2004-2008. The South Dakota source remained slightly larger. Seed production on plants in this trial was sporadic, as it had been in the Field Trial - PMC. Seed was produced on all accessions in 2005 and 2006. Only a few plants within each accession appear to be female and produce seed. Drought in 2006 did not appear to affect plant size. Seed production in 2007 was poor. Size difference between the three accessions was less noticeable in 2007 and 2008. Lack of clipping may have affected growth. The source originating from South Dakota (9086280) continued to be more vigorous in 2008.

3. Field Planting NDPMS-F-0808-RA - Golden Valley County; Cooperator: Scot Steele

The accessions 9082680 and Natrona showed little difference in stand establishment. The estimated stand was less than 1 plant per square foot in each planting on 9/19/2008. Records indicating the specific accession planted in a plot are questionable. The Beach Field Office recorded plants as more robust, more branched, and taller in the plot they thought was planted with 9086280. The accessions performed very similar to each other in 2009-2012. Plant vigor was rated good. There was little or no seed production. Evaluations taken by the Beach Field Office in 2010-2012 showed a vigor rating of 1. Moisture conditions this spring and summer were favorable for good growth.

Table FW-1. Seed Production – fourwing saltbush *Atriplex canescens*.

Year	Amount Harvested(clean bulk lbs)
2002	5.5
2003	3.5
2004	6.0
2005	0.5
2006	20.0
2007	5.0
2008	20.0
2009	32.0
2010	7.0
2011	16.0
2012	9.0

Table FW-2. Forage analysis data-2002 - fourwing saltbush *Atriplex*

Sample	%Total Moisture	%Crude Protein	%Acid Detergent Fiber	%Neutral Detergent Fiber
LF2	0	22.3	15.2	27.0
LF2	16.5	18.6	12.7	22.5
TIP6	0	18.1	26.3	39.7
TIP6	24.1	13.7	20.0	30.1

Table FW-3. Evaluation data, 2003-2004 - fourwing saltbush *Atriplex*

Accession	Date	Plant No.	Height	Spread	Fruit 2004
9082855	09/24/03	1	7	31	
9082855	09/08/04	1	33	62	
9082855	09/24/03	2	4	11	
9082855	09/08/04	2	19	30	
9082855	09/24/03	3	16	22	
9082855	09/08/04	3	31	50	
9082855	09/24/03	4	12	16	
9082855	09/08/04	4	26	47	
9082855	09/24/03	5	13	18	
9082855	09/08/04	5	18	50	yes
9082680	09/24/03	1	12	27	
9082680	09/08/04	1	38	49	
9082680	09/24/03	2	3	29	
9082680	09/08/04	2	31	43	yes
9082680	09/24/03	3	5	26	
9082680	09/08/04	3	28	51	
9082680	09/24/03	4	6	42	
9082680	09/08/04	4	36	50	
9082680	09/24/03	5	15	18	
9082680	09/08/04	5	36	48	yes
Wytana	09/24/03	1	3	20	
Wytana	09/08/04	1	23	46	yes
Wytana	09/24/03	2	3	6	
Wytana	09/08/04	2	dead	x	
Wytana	09/24/03	3	2	4	
Wytana	09/08/04	3	11	14	
Wytana	09/24/03	4	2	5	
Wytana	09/08/04	4	5	23	
Wytana	09/24/03	5	7	3	
Wytana	09/08/04	5	13	23	yes

ACTIVE STUDIES: TECHNICAL REPORT 2010-2012

Study NDPMC-P-0801-RA

Study Title: Virginia wildrye *Elymus virginicus*

Objective: There are no developed northern seed sources of Virginia wildrye commercially available. 'Omaha' is a released variety from Nebraska. The objective of this study is to collect, evaluate and develop a broad genetic base release of Virginia wildrye for use in the Northern Great Plains. Conservation uses could include pasture and hayland planting, wildlife habitat, range seeding, riparian planting, and conservation cover.

Cooperators: USDA, NRCS, Bismarck Plant Materials Center, Bismarck, North Dakota

Description: Virginia wildrye is a native, cool-season, perennial bunchgrass which grows 2-3 feet in height. Leaf blades are flat. It prefers moist soils, heavier soil textures, and is shade tolerant. The spikes are stiffly upright and 2-6 inches long. It can be awned or awnless. There are usually two spikelets/node, heavy glumes (horseshoe-shaped) bowed at the base, and short rigid ligules. Canada wildrye has heads with longer awns, narrower leaf blades, shorter ligules and nodding seed heads when compared to Virginia wildrye. Virginia wildrye is generally considered self-pollinated, but has been found to cross with Canada wildrye. It is divided into four intergrading varieties in the Manual of Grasses for North America (Barkworth et. al).

Distribution: Virginia wildrye is native throughout the United States and Canada from Newfoundland to Alberta, south to Florida and Arizona. It is not considered native in Oregon, California, and Nevada. It prefers moist soil, heavier soil textures, and is shade tolerant. Prime habitat includes bottomlands, low prairies, streambanks, and edges, or under trees of woods or woody draws.

Methods and Materials

Collection: Seed collections began in 2008 and were completed in 2009. PMC and other NRCS field, State, and Area office personnel collected seed. Table VW-1 is a list of 2008 and 2009 collections. Collections were from a wide array of sites including city parks. Plants were diverse in size and shape

Propagation: Seed was planted in February into containers (yellow) in the greenhouse. Seed was planted into a soilless potting mix. There were 1-2 seeds per cone planted. The seed had no special treatment prior to planting. Seed germinated very well and seedlings were vigorous.

Planting: Seedlings grown in the greenhouse were planted at the PMC on 5/20/2010 into an evaluation plot. See Table VW-1 for map. Each accession was planted in three-plant plots and in three replications (9 plants total for each accession).

Evaluation:

2010: Plants were evaluated based on growth habit and size. See Table VW-2. Superior looking plants were rated for their potential use as a forage plant or as a landscape plant. In 2010, fifteen seed heads were collected from each preselected plant, so seed would be available quicker if chosen as part of a release. See Table VW-2.

2011: Plants were visually compared when most plants were vegetative and again just prior to flowering. Plants of small stature, extremely early or late flowering, diseased, poor vigor, and poor overall plant size were flagged and plants were dug and removed from the assembly. Plant from all but three of the accessions were included in the remaining population. Table VW-3 is a list of the accessions remaining in the population, the number of plants of each within the assembly block, and the state and county of origin. Seed from the remaining plants was harvested using a plot combine.

2012: No additional selection was done. Seed was harvested from the selected assembly.

Maintenance:

2010: Weeds were controlled by tilling between the rows and hand weeding. No chemical was applied. Residue was removed by mowing the plants in the fall.

2011: Weeds were controlled by mowing between the rows and hand weeding. Seed that had dropped in 2010 formed a dense mat of plants between the rows.

2012: Weeds were controlled by mowing between the rows and hand weeding.

Results and Discussion

Virginia wildrye grows in diverse conditions and locations throughout South Dakota, Minnesota, and North Dakota. As the species is mostly self-pollinated, parent plants from a variety of locations would provide a diverse population. The plants were very vigorous and many produced seed in 2010, the year of transplanting. There appears to be two general types of growth habit. One is very upright, tall, and wide leaved. The other is shorter and sprawling with narrow leaves. Both types remain in the selected population. Drought in 2012 resulted in lower seed production than in 2011. Plants appeared stressed in the drought, but did not die. Many of the seed collections were made in shady sites. The assembly was planted in direct sun and appeared to grow just as well.

The 2011 seed harvest was 78 clean bulk pounds (66.5 PLS). The seed harvest in 2012 was less due to drought conditions. The 2012 seed harvest was 55 bulk pounds. Virginia wildrye seed has not been difficult to clean using a fanning mill. It did not require debearding.

Planting of a foundation seed production field is planned for 2013.

Table VW-1. Collections – Virginia wildrye *Elymus virginicus*

Accession	State	County	Collector	Coll. Date	Other
9092245	ND	Richland	Tober	08/08/08	Sheyenne National Grasslands
9092246	ND	Cass	Tober	08/08/08	Conservancy Park on S. Univ. St., Fargo
9092247	MN	Clay	Tober	08/08/08	Regional Science Center 10 mi E of Fargo
9092248	ND	Ransom	Tober	08/08/08	Little Yellowstone Park - east end
9092249	ND	Morton	Jensen	08/11/08	Fort Lincoln State Park, walking trail
9092250	MN	Aitkin	Kopp	08/18/08	8-9 mi E of Hill City on Hwy 200
9092251	MN	Mille Lacs	Tober, Kopp	08/18/08	city park in NW Milaca along Rum River
9092252	ND	Walsh	Tober	08/18/08	Tom Silewski EWP, Exit 172 off I-29
9092253	MN	Aitkin	Tober, Kopp	08/18/08	Hwy 200 E of Hill City, boat ramp
9092254	MN	Sherburne	Tober	08/20/08	Hwy 24 S of Clearwater, Miss. River access
9092255	MN	Sherburne	Kopp	08/20/08	Hwy 24 public access, Miss. River
9092256	MN	Aitkin	Tober, Kopp	08/18/08	Big Sandy Lake Rec Area, Hwy 200 N entrance
9092257	SD	Beadle	Brannan, Yapp	08/20/08	James River Access boat ramp parking lot
9092258	ND	Oliver	Soil Con Training	08/28/08	Smith Grove, along trail to Big Trees
9092259	ND	Emmons	Jensen, Bergsagel	09/13/08	Seeman Park, E of Linton, Hwy 13
9092260	ND	Logan	Bergsagel, Jensen	09/13/08	Beaver Lake State Park, near obelisk
9094261	MN	Rice	Coffman	09/08/08	Jct Co 29 & MN 3, SW side of MN 3
9094262	ND	Morton	Duckwitz	09/06/08	NE1/4 sec 31-T81-R140 below dam
9094263	SD	Clay	Jensen	09/10/08	sec8-T93N-R52W log cabin on bluff road
9094264	SD	Clay	Jensen	09/10/08	Clay Co. Park sec 20-T92N-R52W
9094265	SD	Yankton	Jensen	09/10/08	Clay Creek, S of Volin, sec26-T94N-R54W
9094266	SD	Union	Jensen	09/10/08	Union Grove State Park ,sec32-T94N-R50W
9094267	ND	Oliver	Jensen, Bergsagel	09/13/08	Arroda Lakes - west entrance
9094268	ND	Mercer	Bergsagel, Jensen	09/16/08	Stanton City Park along Knife River
9094269	ND	Mercer	Jensen, Bergsagel	09/13/08	Sakakawea Estates; S of Lake Sakakawea
9094270	ND	Dunn	Bergsagel, Jensen	09/16/08	Killdeer Mt WMA drainage area, NW parking lot
9094271	ND	Stark	Jensen, Bergsagel	09/16/08	Schnell Ranch -Woodland Trail (OWLS)
9094272	ND	Barnes	Jensen	10/02/08	Conservancy Park along Sheyenne River S of Valley City, woods - north end
9094273	SD	Hanson	Adams, Gilb	08/22/08	James River banks 8-T101N-R58W
9094274	SD	Dewey	Richter, Beer, Boltjes	10/02/08	Virgin Creek, 28-T15N-R29E
9094275	ND	Kidder	Jensen, Tober	10/08/08	Lake Isabel, E side, 26-T139N-72W
9094276	ND	Griggs	Tober	10/08/08	Red Willow Lake Resort Rd to Heifer Stadium
9094277	MN	Polk	Jensen	10/08/08	Roger Wagner Nursery, Red Lake River bottoms
9094278	ND	Nelson	Tober, Jensen	10/08/08	Stump Lake Recreation Area

Accession	State	County	Collector	Coll. Date	Other
9094283	MN	Marshall	Gustafson,Rivard,Kaul	09/01/09	sec30-T157N-R50W EWP
9094284	MN	Marshall	Gustafson,Rivard,Kaul	09/01/09	sec27-T157N-R50W EWP
9094285	MN	Red Lake	Shawnn Balstad	08/24/09	Riverside Park, north of watergrazing station
9094286	SD	Corson	Jensen, Bergsagel	09/08/09	South of Little Eagle along SD 63, Sec 29 T20N R27E
9094287	SD	Jackson	Jensen, Bergsagel	09/10/09	Hwy 44 Bear in the Lodge Creek; 12-T41N-R38W, W of Wanblee, SD
9094288	SD	Custer	Jensen, Bergsagel	09/09/09	Beaver Creek in Wind Cave National Park
9094289	SD	Harding	Jensen, Bergsagel	09/08/09	Slim Buttes (Reva campgrounds)
9094290	SD	Shannon	Jensen, Bergsagel	09/10/09	11 mi N Oglala along Hwy 41, White River bridge
9094291	SD	Mellette	Jensen, Bergsagel	09/10/09	Off Hwy 44, 5 1/2 E of SD Hwy 63, woody draws
9094292	SD	Perkins	Jensen, Bergsagel	09/08/09	Humphrey Draw, Grand River National Grasslands
9094293	SD	Fall River	Jensen, Bergsagel	09/10/09	Brookside Park in city of Hot Springs
9094294	SD	Stanley	Jensen, Bergsagel	09/11/09	Off Hwy 1806 near Oahe Dam, mile mark 191
9094295	SD	Butte	Jensen, Bergsagel	09/09/09	T8N-R2E City of Belle Fourche walking trail
9094296	SD	Lawrence	Jensen, Bergsagel	09/09/09	Rough Lock Falls Trail Head, campground
9094297	SD	Roberts	Tober	09/17/09	Siche Hollow, scattered locations along trail
9094298	SD	Roberts	Tober	09/17/09	Browns Valley, MN COE Rec area north of Lake Traverse(city)
9094299	SD	Big Stone	Tober	09/17/09	Graceville, MN - west end of Toqua Park
9094300	MN	Douglas	Tober	09/16/09	Spruce Hill Park N of Alexandria 20 mi., drainage from picnic shelters, footbridge
9094301	MN	Wadena	Tober	09/16/09	Old Wadena along Crow Wing River by canoe landing and picnic area
9094302	MN	Beltrami	Tober	09/14/09	6 mi S of Blackduck on Hwy 39; Gilstad Lake boat ramp area in trees
9094303	MN	Norman	Tober	09/14/09	Bosworth Park along Marsh River at Ada, MN
9094304	SD	Hutchinson	Jensen	09/21/09	Walz GMA; 7 mi N of Menno, SD along 431st Av - woody draws
9094305	SD	Hand	Jensen	09/17/09	St. Lawrence Nature Park east side of town by old pavilion
9094307	MN	Carlton	Jensen, M. Oja	09/30/09	Cloquet Forest, cut forest area by global warming trial
9094308	SD	Grant	Jensen, Bergsagel	10/07/09	S of Twin Brooks, from Hwy 20, 1 mi N to 156st, E 1 mi, then S on 473 Av 1/10 mi
9094309	ND	McHenry	Jensen, Bergsagel	10/08/09	Velva City Park, along Mouse River riparian area near horseshoe pit
9094310	ND	McLean	Jensen, Bergsagel	10/08/09	Ft Mandan, in trees N of Seeman sculpture
9094311	MN	Yellow Medicine	Jensen, Bergsagel	10/07/09	N of Canby at Yellow Medicine/Lac Qui Parle Co line; 280 Av 1/2 mi E of Hwy 75
9094312	MN	Lac Qui Parle	Jensen, Bergsagel	10/07/09	S of Madison, MN, on 211 Ave near bridge #37513
9094313	MN	Sherburne	Tober	09/28/09	Princeton, MN Riverside Park (Hwy 95) along Rum River
9094314	SD	Brookings	Jensen, Bergsagel	10/07/09	S of Brookings, off of Co. Rd 77, at Conservation Park along Big Sioux River
9094315	SD	Minnehaha	Jensen, Bergsagel	10/06/09	Dell Rapids City Park by old Bath House along Big Sioux River
9094316	MN	Pipestone	Jensen, Bergsagel	10/06/09	Pipestone National Monument trail near headquarters
9094317	MN	Murray	Jensen, Bergsagel	10/06/09	Lime Lake Park (Murray Co. Park) W of Avoca, MN; along dam face
9094318	MN	Cottonwood	Jensen, Bergsagel	10/06/09	High Water Creek along Hwy 10, just E of Co. Rd 5, baseball area at bridge

Accession	State	County	Collector	Coll. Date	Other
9094319	MN	Redwood	Jensen, Bergsagel	10/06/09	Plum Creek Co. Park 2 mi S of Walnut Grove, near foot bridge
9094320	MN	Lyon	Jensen, Bergsagel	10/06/09	Garvin Park N of Hwy 14; 280th Av & Co. Rd 69, picnic area along creek
9094321	MN	Lincoln	Jensen, Bergsagel	10/06/09	Lake Benton; Hole in Mountain Co. Park, outer edge of hills and draws
9094322	SD	Marshall	Jensen, Bergsagel	10/05/09	GF&P walk in area, 2 mi W of Veblen, SD(Hwy 25) along creek in draw
9094323	ND	McKenzie	Bergsagel	10/04/09	Bennie Peer Rd, 3.3 mi W of Hwy 16; E of Tim Dwyer place (Little Mo. Grasslands)
9094324	ND	Golden Valley	Bergsagel	10/04/09	Buffalo Gap Campground, along I-94, sites 20, 22 in center of Hidatsu Loop
9094325	ND	Burleigh	Jensen, Bergsagel	09/02/09	Sibley Park south of Bismarck, east end of park, west of boat ramp, woods
9094326	MN	Lac Qui Parle	L. Kvidera	10/13/09	Sec 21-T117N-R44W, N side of Lac Qui Parle River, Co. Rd. #37
9094327	ND	Renville	Jensen, Bergsagel	10/19/09	Upper Souris National Wildlife Refuge, N of Mouse River Co Prk, W of Mohall
9094328	ND	Bottineau	Jensen, Bergsagel	10/19/09	Lake Metigoshe State Park - Day Use and Tent Loop
9094329	ND	Mountrail	Jensen, Bergsagel	10/19/09	1.7 mi S of Hwy 2, W of White Earth Rest Area
9094330	ND	Ward	Jensen, Bergsagel	10/19/09	Oak Park in Minot, at Camp Owetti along trail along Mouse River (Souris)

Figure VW-1. Plot Layout – Virginia wildrye *Elymus virginicus* (page 1 of 3)

Location: Panel A
 Planting Date: 5/20/2010

row 1	row 2	row 3	row 4	row 5	row 6	row 7	row 8	row 9	row 10
9092245	9092254	9094263	9094272	9094285	9094294	9094303	9094313	9094322	Cuivre
9092245	9092254	9094263	9094272	9094285	9094294	9094303	9094313	9094322	Cuivre
9092245	9092254	9094263	9094272	9094285	9094294	9094303	9094313	9094322	Cuivre
9092246	9092255	9094264	9094273	9094286	9094295	9094304	9094314	9094323	EWP
9092246	9092255	9094264	9094273	9094286	9094295	9094304	9094314	9094323	EWP
9092246	9092255	9094264	9094273	9094286	9094295	9094304	9094314	9094323	EWP
9092247	9092256	9094265	9094274	9094287	9094296	9094305	9094315	9094324	9094276
9092247	9092256	9094265	9094274	9094287	9094296	9094305	9094315	9094324	9094276
9092247	9092256	9094265	9094274	9094287	9094296	9094305	9094315	9094324	9094276
9092248	9092257	9094266	9094275	9094288	9094297	9094307	9094316	9094325	9094317
9092248	9092257	9094266	9094275	9094288	9094297	9094307	9094316	9094325	9094317
9092248	9092257	9094266	9094275	9094288	9094297	9094307	9094316	9094325	9094317
9092249	9092258	9094267	9094276	9094289	9094298	9094308	9094317	9094326	9094288
9092249	9092258	9094267	9094276	9094289	9094298	9094308	9094317	9094326	9094288
9092249	9092258	9094267	9094276	9094289	9094298	9094308	9094317	9094326	9094288
9092250	9092259	9094268	9094277	9094290	9094299	9094309	9094318	9094327	9092256
9092250	9092259	9094268	9094277	9094290	9094299	9094309	9094318	9094327	9092256
9092250	9092259	9094268	9094277	9094290	9094299	9094309	9094318	9094327	9092256
9092251	9092260	9094269	9094278	9094291	9094300	9094310	9094319	9094328	9094267
9092251	9092260	9094269	9094278	9094291	9094300	9094310	9094319	9094328	9094267
9092251	9092260	9094269	9094278	9094291	9094300	9094310	9094319	9094328	9094267
9092252	9094261	9094270	9094283	9094292	9094301	9094311	9094320	9094329	9094290
9092252	9094261	9094270	9094283	9094292	9094301	9094311	9094320	9094329	9094290
9092252	9094261	9094270	9094283	9094292	9094301	9094311	9094320	9094329	9094290
9092253	9094262	9094271	9094284	9094293	9094302	9094312	9094321	9094330	9094285
9092253	9094262	9094271	9094284	9094293	9094302	9094312	9094321	9094330	9094285
9092253	9094262	9094271	9094284	9094293	9094302	9094312	9094321	9094330	9094285

Figure VW-1. Plot Layout – Virginia wildrye *Elymus virginicus* (continued - page 2 of 3)

Location: Panel A
 Planting Date: 5/20/2010

row 11	row 12	row 13	row 14	row 15	row 16	row 17	row 18	row 19	row 20
9094329	9094283	9094299	9094278	9094289	9094326	9094325	9092250	9094268	9094271
9094329	9094283	9094299	9094278	9094289	9094326	9094325	9092250	9094268	9094271
9094329	9094283	9094299	9094278	9094289	9094326	9094325	9092250	9094268	9094271
9094293	9094295	9092252	9094312	9094321	9094323	9092254	9092258	9094308	9094287
9094293	9094295	9092252	9094312	9094321	9094323	9092254	9092258	9094308	9094287
9094293	9094295	9092252	9094312	9094321	9094323	9092254	9092258	9094308	9094287
9092249	9092247	9094277	9094330	9094305	9094316	9094315	9092245	9094307	9092258
9092249	9092247	9094277	9094330	9094305	9094316	9094315	9092245	9094307	9092258
9092249	9092247	9094277	9094330	9094305	9094316	9094315	9092245	9094307	9092258
9094266	Cuivre	9092260	9094298	9094265	9094324	9094273	9094294	9094309	9092259
9094266	Cuivre	9092260	9094298	9094265	9094324	9094273	9094294	9094309	9092259
9094266	Cuivre	9092260	9094298	9094265	9094324	9094273	9094294	9094309	9092259
9094275	9094284	9094272	9094297	9094264	9094263	9094269	9092257	9094317	9094325
9094275	9094284	9094272	9094297	9094264	9094263	9094269	9092257	9094317	9094325
9094275	9094284	9094272	9094297	9094264	9094263	9094269	9092257	9094317	9094325
9094318	9094302	EWP	9094303	9094292	9094270	9094261	9094287	9094283	9094310
9094318	9094302	EWP	9094303	9094292	9094270	9094261	9094287	9094283	9094310
9094318	9094302	EWP	9094303	9094292	9094270	9094261	9094287	9094283	9094310
9094313	9092248	9094300	9094319	9094322	9094314	9094327	9094328	9094316	9094300
9094313	9092248	9094300	9094319	9094322	9094314	9094327	9094328	9094316	9094300
9094313	9092248	9094300	9094319	9094322	9094314	9094327	9094328	9094316	9094300
9094296	9094291	9094274	9094304	9094286	9092255	9092253	9094262	9092257	9094321
9094296	9094291	9094274	9094304	9094286	9092255	9092253	9094262	9092257	9094321
9094296	9094291	9094274	9094304	9094286	9092255	9092253	9094262	9092257	9094321
9092246	9094301	9092251	9094310	9094271	9092259	9094320	9094311	9094292	9094266
9092246	9094301	9092251	9094310	9094271	9092259	9094320	9094311	9094292	9094266
9092246	9094301	9092251	9094310	9094271	9092259	9094320	9094311	9094292	9094266

Figure VW-1. Plot Layout – Virginia wildrye *Elymus virginicus* (continued - page 3 of 3)

Location: Panel A
 Planting Date: 5/20/2010

row 21	row 22	row 23	row 24	row 25	row 26	row 27	row 28
9094276	9094275	9094261	9092248	9094323	9094318	9092254	9094270
9094276	9094275	9094261	9092248	9094323	9094318	9092254	9094270
9094276	9094275	9094261	9092248	9094323	9094318	9092254	9094270
9094312	9092245	9094326	9094298	9094328	9094305	9094300	9092252
9094312	9092245	9094326	9094298	9094328	9094305	9094300	9092252
9094312	9092245	9094326	9094298	9094328	9094305	9094300	9092252
9092255	9094327	9094267	9094286	9094262	9094295	Cuivre	9094301
9092255	9094327	9094267	9094286	9094262	9094295	Cuivre	9094301
9092255	9094327	9094267	9094286	9094262	9094295	Cuivre	9094301
9094308	9094288	9094294	9094320	9094303	9094274	9094265	9094296
9094308	9094288	9094294	9094320	9094303	9094274	9094265	9094296
9094308	9094288	9094294	9094320	9094303	9094274	9094265	9094296
9094329	9094273	9094324	9094313	9092260	9094297	9094264	9094269
9094329	9094273	9094324	9094313	9092260	9094297	9094264	9094269
9094329	9094273	9094324	9094313	9092260	9094297	9094264	9094269
9094289	9094263	9094304	9094322	9092251	9094268	EWP	9094290
9094289	9094263	9094304	9094322	9092251	9094298	EWP	9094290
9094289	9094263	9094304	9094322	9092251	9094268	EWP	9094290
9094314	9092253	9094302	9092250	9094278	9094319	9094272	
9094314	9092253	9094302	9092250	9094278	9094319	9094272	
9094314	9092253	9094302	9092250	9094278	9094319	9094272	
9092247	9094309	9094284	9092256	9094277	9094299	9092249	
9092247	9094309	9094284	9092256	9094277	9094299	9092249	
9092247	9094309	9094284	9092256	9094277	9094299	9092249	
9094315	9094293	9094285	9094291	9092246	9094307	9094311	
9094315	9094293	9094285	9094291	9092246	9094307	9094311	
9094315	9094293	9094285	9094291	9092246	9094307	9094311	

Table VW-2. 2010 Evaluation data – Virginia wildrye *Elymus virginicus*

Row	Plant	Accession	2010 Forage preselect	9/27/2010 Ht rating 1=tall 3=short	2010 HV turf/short preselect
1	1	9092245		2	
1	2	9092245		2	
1	3	9092245		2	
1	1	9092246		2	
1	2	9092246		2	
1	3	9092246		2	
1	1	9092247	x	1	
1	2	9092247		1	
1	3	9092247		1	
1	1	9092248		3	x
1	2	9092248		3	x
1	3	9092248		3	x
1	1	9092249		2	
1	2	9092249		2	
1	3	9092249		2	
1	1	9092250	x	1	
1	2	9092250	x	1	
1	3	9092250		1	
1	1	9092251		1	
1	2	9092251		1	
1	3	9092251	x	1	
1	1	9092252		1	
1	2	9092252		1	
1	3	9092252	x	1	
1	1	9092253		1	
1	2	9092253		1	
1	3	9092253		1	
		ROW 2			
2	1	9092254		1	
2	2	9092254		1	
2	3	9092254	x	1	
2	1	9092255	x	1	
2	2	9092255	x	1	
2	3	9092255	x	1	
2	1	9092256		2	
2	2	9092256		2	
2	3	9092256		1	
2	1	9092257		1	
2	2	9092257		1	
2	3	9092257		1	
2	1	9092258		3	
2	2	9092258		3	x
2	3	9092258		3	x
2	1	9092259		2	
2	2	9092259		2	
2	3	9092259		2	
2	1	9092260		2	
2	2	9092260		2	

Row	Plant	Accession	2010 Forage preselect	9/27/2010 Ht rating 1=tall 3=short	2010 HV turf/short preselect
2	3	9092260		2	
2	1	9094261		1	
2	2	9094261		2	
2	3	9094261	x	1	
2	1	9094262		2	
2	2	9094262		2	
2	3	9094262		2	
ROW 3					
3	1	9094263		2	
3	2	9094263		2	
3	3	9094263		2	
3	1	9094264		3	
3	2	9094264		3	
3	3	9094264		3	
3	1	9094265		1	
3	2	9094265	x	1	
3	3	9094265		1	
3	1	9094266		3	x
3	2	9094266		1	
3	3	9094266		2	
3	1	9094267		2	
3	2	9094267		2	
3	3	9094267		2	
3	1	9094268		1	
3	2	9094268		1	
3	3	9094268		2	
3	1	9094269		2	
3	2	9094269		2	
3	3	9094269		2	
3	1	9094270		2	
3	2	9094270		2	
3	3	9094270		2	
3	1	9094271		3	
3	2	9094271		3	
3	3	9094271		2	
ROW 4					
4	1	9094272		2	
4	2	9094272		3	
4	3	9094272	x	2	
4	1	9094273		3	
4	2	9094273		3	
4	3	9094273		2	
4	1	9094274		2	
4	2	9094274		2	
4	3	9094274		2	
4	1	9094275		2	
4	2	9094275		2	
4	3	9094275		2	
4	1	9094276		3	

Row	Plant	Accession	2010 Forage preselect	9/27/2010 Ht rating 1=tall 3=short	2010 HV turf/short preselect
4	2	9094276		3	
4	3	9094276		3	
4	1	9094277		1	
4	2	9094277	x	1	
4	3	9094277		2	
4	1	9094278		2	
4	2	9094278		2	
4	3	9094278		1	
4	1	9094283	x	1	
4	2	9094283		1	
4	3	9094283	x	1	
4	1	9094284		1	
4	2	9094284	x	1	
4	3	9094284		2	
ROW 5					
5	1	9094285		2	
5	2	9094285		2	
5	3	9094285	x	1	
5	1	9094286		1	
5	2	9094286		1	
5	3	9094286		2	
5	1	9094287		3	x
5	2	9094287		3	x
5	3	9094287		3	x
5	1	9094288		2	
5	2	9094288		2	
5	3	9094288		2	
5	1	9094289		3	
5	2	9094289		2	
5	3	9094289		2	
5	1	9094290		1	
5	2	9094290		2	
5	3	9094290		2	
5	1	9094291		1	
5	2	9094291		2	
5	3	9094291		2	
5	1	9094292		2	
5	2	9094292		2	
5	3	9094292		2	
5	1	9094293		1	
5	2	9094293		1	
5	3	9094293		1	
ROW 6					
6	1	9094294		2	
6	2	9094294		1	
6	3	9094294		1	
6	1	9094295		1	
6	2	9094295		2	
6	3	9094295		2	

Row	Plant	Accession	2010 Forage preselect	9/27/2010 Ht rating 1=tall 3=short	2010 HV turf/short preselect
6	1	9094296		2	
6	2	9094296		2	
6	3	9094296		2	
6	1	9094297		2	
6	2	9094297		1	
6	3	9094297		2	
6	1	9094298	x	1	
6	2	9094298	x	1	
6	3	9094298	x	1	
6	1	9094299		2	
6	2	9094299		2	
6	3	9094299		2	
6	1	9094300	x	1	
6	2	9094300		1	
6	3	9094300		2	
6	1	9094301	x	1	
6	2	9094301		1	
6	3	9094301		2	
6	1	9094302		1	
6	2	9094302		1	
6	3	9094302		1	
ROW 7					
7	1	9094303		2	
7	2	9094303		2	
7	3	9094303		2	
7	1	9094304		2	
7	2	9094304		2	
7	3	9094304		2	
7	1	9094305		2	x
7	2	9094305		3	x
7	3	9094305		2	x
7	1	9094307		2	
7	2	9094307		2	
7	3	9094307		1	
7	1	9094308		2	
7	2	9094308		2	
7	3	9094308		2	
7	1	9094309		2	
7	2	9094309		1	
7	3	9094309		2	
7	1	9094310		1	
7	2	9094310	x	1	
7	3	9094310		1	
7	1	9094311	x	1	
7	2	9094311		1	
7	3	9094311		1	
7	1	9094312	x	1	
7	2	9094312	x	2	
7	3	9094312	x	1	

Row	Plant	Accession	2010 Forage preselect	9/27/2010 Ht rating 1=tall 3=short	2010 HV turf/short preselect
ROW 8					
8	1	9094313		2	
8	2	9094313	x	1	
8	3	9094313	x	1	
8	1	9094314	x	1	
8	2	9094314		2	
8	3	9094314	x	1	
8	1	9094315		2	
8	2	9094315		2	
8	3	9094315		2	x
8	1	9094316		2	
8	2	9094316		1	
8	3	9094316		1	
8	1	9094317		2	
8	2	9094317		2	
8	3	9094317		2	
8	1	9094318	x	1	
8	2	9094318	x	1	
8	3	9094318	x	1	
8	1	9094319		1	
8	2	9094319		1	
8	3	9094319		1	
8	1	9094320		2	
8	2	9094320		1	
8	3	9094320		3	
8	1	9094321		2	x
8	2	9094321		2	x
8	3	9094321		2	x
ROW 9					
9	1	9094322		3	
9	2	9094322		2	
9	3	9094322		2	
9	1	9094323		2	
9	2	9094323		2	
9	3	9094323		3	
9	1	9094324		3	
9	2	9094324		2	
9	3	9094324		2	
9	1	9094325		1	
9	2	9094325		1	
9	3	9094325		1	
9	1	9094326		1	
9	2	9094326	x	1	
9	3	9094326	x	1	
9	1	9094327		1	
9	2	9094327		2	
9	3	9094327		2	
9	1	9094328		3	
9	2	9094328		3	

Row	Plant	Accession	2010 Forage preselect	9/27/2010 Ht rating 1=tall 3=short	2010 HV turf/short preselect
9	3	9094328		3	
9	1	9094329		1	
9	2	9094329		1	
9	3	9094329		3	
9	1	9094330		2	
9	2	9094330		3	
9	3	9094330		2	
		ROW 10			
10	1	Cuivre		2	
10	2	Cuivre		1	
10	3	Cuivre		1	
10	1	EWP		1	
10	2	EWP		1	
10	3	EWP	x	1	
10	1	9094276		3	
10	2	9094276		3	
10	3	9094276		3	
10	1	9094317		2	
10	2	9094317		3	
10	3	9094317		3	
10	1	9094288		3	
10	2	9094288		2	
10	3	9094288		1	
10	1	9092256		1	
10	2	9092256		1	
10	3	9092256	x	1	
10	1	9094267		2	
10	2	9094267		2	
10	3	9094267		2	
10	1	9094290		2	
10	2	9094290		1	
10	3	9094290		3	
10	1	9094285		3	
10	2	9094285		3	
10	3	9094285		1	
		ROW 11			
11	1	9094329		3	
11	2	9094329		3	
11	3	9094329		2	
11	1	9094293		1	
11	2	9094293		2	
11	3	9094293		2	
11	1	9092249		3	
11	2	9092249		3	
11	3	9092249		3	
11	1	9094266		1	
11	2	9094266		1	
11	3	9094266		3	
11	1	9094275		3	

Row	Plant	Accession	2010 Forage preselect	9/27/2010 Ht rating 1=tall 3=short	2010 HV turf/short preselect
11	2	9094275		3	
11	3	9094275		2	
11	1	9094318		1	
11	2	9094318		1	
11	3	9094318	x	1	
11	1	9094313		1	
11	2	9094313	x	1	
11	3	9094313		1	
11	1	9094296		2	
11	2	9094296		2	
11	3	9094296		2	
11	1	9092246		1	
11	2	9092246		1	
11	3	9092246		1	
		ROW 12			
12	1	9094283		2	
12	2	9094283		1	
12	3	9094283	x	1	
12	1	9094295		1	
12	2	9094295	x	1	
12	3	9094295		2	
12	1	9092247	x	1	
12	2	9092247		1	
12	3	9092247		1	
12	1	Cuivre		1	
12	2	Cuivre		2	
12	3	Cuivre		2	
12	1	9094284		1	
12	2	9094284	x	1	
12	3	9094284	x	1	
12	1	9094302		1	
12	2	9094302		1	
12	3	9094302	x	1	
12	1	9092248		2	x
12	2	9092248		2	x
12	3	9092248		2	x
12	1	9094291		2	
12	2	9094291		3	
12	3	9094291		2	
12	1	9094301	x	1	
12	2	9094301	x	1	
12	3	9094301		1	
		ROW 13			
13	1	9094299		3	
13	2	9094299		3	x
13	3	9094299		2	
13	1	9092252		1	
13	2	9092252	x	1	
13	3	9092252		1	

Row	Plant	Accession	2010 Forage preselect	9/27/2010 Ht rating 1=tall 3=short	2010 HV turf/short preselect
13	1	9094277	x	1	
13	2	9094277		1	
13	3	9094277		1	
13	1	9092260		3	
13	2	9092260		3	
13	3	9092260		2	
13	1	9094272	x	1	
13	2	9094272		2	
13	3	9094272		2	
13	1	EWP		1	
13	2	EWP	x	1	
13	3	EWP		1	
13	1	9094300		1	
13	2	9094300		1	
13	3	9094300		1	
13	1	9094274		3	
13	2	9094274		2	x
13	3	9094274		1	
13	1	9092251		1	
13	2	9092251		1	
13	3	9092251		1	
		ROW 14			
14	1	9094278		2	
14	2	9094278		2	
14	3	9094278		2	
14	1	9094312	x	1	
14	2	9094312	x	1	
14	3	9094312		1	
14	1	9094330		2	
14	2	9094330		2	x
14	3	9094330		2	x
14	1	9094298		1	
14	2	9094298	x	1	
14	3	9094298		1	
14	1	9094297		1	
14	2	9094297		1	
14	3	9094297		1	
14	1	9094303		1	
14	2	9094303		1	
14	3	9094303	x	1	
14	1	9094319		1	
14	2	9094319		1	
14	3	9094319		1	
14	1	9094304		2	
14	2	9094304		2	
14	3	9094304		3	
14	1	9094310		1	
14	2	9094310		1	
14	3	9094310		1	

Row	Plant	Accession	2010 Forage preselect	9/27/2010 Ht rating 1=tall 3=short	2010 HV turf/short preselect
ROW 15					
15	1	9094289		3	
15	2	9094289		3	
15	3	9094289		2	
15	1	9094321		2	
15	2	9094321		2	
15	3	9094321		2	
15	1	9094305		3	x
15	2	9094305		3	x
15	3	9094305		3	x
15	1	9094265		1	
15	2	9094265		1	
15	3	9094265		1	
15	1	9094264		2	
15	2	9094264		2	
15	3	9094264		2	
15	1	9094292		2	
15	2	9094292		2	
15	3	9094292		2	
15	1	9094322		2	
15	2	9094322		2	
15	3	9094322		2	
15	1	9094286		1	
15	2	9094286		1	
15	3	9094286		1	
15	1	9094271		2	
15	2	9094271		2	
15	3	9094271		2	
ROW 16					
16	1	9094326		1	
16	2	9094326		1	
16	3	9094326	x	1	
16	1	9094323		1	
16	2	9094323	x	1	
16	3	9094323		2	
16	1	9094316		2	
16	2	9094316		2	
16	3	9094316		2	
16	1	9094324		2	
16	2	9094324		2	
16	3	9094324		2	
16	1	9094263		1	
16	2	9094263		2	
16	3	9094263		2	
16	1	9094270		2	
16	2	9094270		2	
16	3	9094270		1	
16	1	9094314		1	
16	2	9094314	x	1	

Row	Plant	Accession	2010 Forage preselect	9/27/2010 Ht rating 1=tall 3=short	2010 HV turf/short preselect
16	3	9094314		2	
16	1	9092255		1	
16	2	9092255	x	1	
16	3	9092255		1	
16	1	9092259		2	
16	2	9092259		1	
16	3	9092259		2	
ROW 17					
17	1	9094325		2	
17	2	9094325		1	
17	3	9094325		1	
17	1	9092254		1	
17	2	9092254		2	
17	3	9092254	x	1	
17	1	9094315		2	
17	2	9094315		2	x
17	3	9094315		2	x
17	1	9094273		1	
17	2	9094273		1	
17	3	9094273		1	
17	1	9094269		2	
17	2	9094269		1	
17	3	9094269		2	
17	1	9094261		1	
17	2	9094261		1	
17	3	9094261		1	
17	1	9094327		2	
17	2	9094327		2	
17	3	9094327		3	
17	1	9092253		1	
17	2	9092253		1	
17	3	9092253		1	
17	1	9094320		1	
17	2	9094320		1	
17	3	9094320		1	
ROW 18					
18	1	9092250		2	
18	2	9092250		1	
18	3	9092250		1	
18	1	9092258		2	
18	2	9092258		2	x
18	3	9092258		2	x
18	1	9092245		2	x
18	2	9092245		2	x
18	3	9092245		2	
18	1	9094294		1	
18	2	9094294		2	
18	3	9094294		1	
18	1	9092257	x	2	

Row	Plant	Accession	2010 Forage preselect	9/27/2010 Ht rating 1=tall 3=short	2010 HV turf/short preselect
18	2	9092257		2	
18	3	9092257		3	
18	1	9094287		3	x
18	2	9094287		3	x
18	3	9094287		3	x
18	1	9094328		3	
18	2	9094328		3	
18	3	9094328		3	
18	1	9094262		2	
18	2	9094262		2	
18	3	9094262		2	
18	1	9094311		1	
18	2	9094311		1	
18	3	9094311	x	1	
ROW 19					
19	1	9094268		2	
19	2	9094268		1	
19	3	9094268		1	
19	1	9094308		1	
19	2	9094308		2	
19	3	9094308		2	
19	1	9094307		3	x
19	2	9094307		2	
19	3	9094307		2	
19	1	9094309		2	x
19	2	9094309		2	
19	3	9094309		2	
19	1	9094317		2	
19	2	9094317		2	x
19	3	9094317		2	x
19	1	9094283		1	
19	2	9094283	x	1	
19	3	9094283	x	1	
19	1	9094316		1	
19	2	9094316		1	
19	3	9094316		1	
19	1	9092257		1	
19	2	9092257		1	
19	3	9092257		1	
19	1	9094292		2	
19	2	9094292		2	
19	3	9094292		2	
ROW 20					
20	1	9094271		3	
20	2	9094271		2	
20	3	9094271		2	
20	1	9094287		2	
20	2	9094287		2	
20	3	9094287		2	x

Row	Plant	Accession	2010 Forage preselect	9/27/2010 Ht rating 1=tall 3=short	2010 HV turf/short preselect
20	1	9092258		2	
20	2	9092258		2	
20	3	9092258		2	
20	1	9092259		2	
20	2	9092259		2	
20	3	9092259		1	
20	1	9094325		1	
20	2	9094325		1	
20	3	9094325		1	
20	1	9094310		3	
20	2	9094310		2	
20	3	9094310		1	
20	1	9094300	x	2	
20	2	9094300		1	
20	3	9094300		1	
20	1	9094321		2	x
20	2	9094321		2	x
20	3	9094321		2	
20	1	9094266		1	
20	2	9094266		1	
20	3	9094266		2	
		ROW 21			
21	1	9094276		3	
21	2	9094276		3	
21	3	9094276		2	
21	1	9094312	x	1	
21	2	9094312	x	1	
21	3	9094312	x	1	
21	1	9092255		1	
21	2	9092255		1	
21	3	9092255	x	1	
21	1	9094308		2	
21	2	9094308		2	
21	3	9094308		2	
21	1	9094329		2	
21	2	9094329		2	
21	3	9094329		3	
21	1	9094289		2	
21	2	9094289		2	
21	3	9094289		2	
21	1	9094314		1	
21	2	9094314		2	x
21	3	9094314		2	x
21	1	9092247		3	
21	2	9092247		3	
21	3	9092247		2	
21	1	9094315		2	x
21	2	9094315		2	x
21	3	9094315		1	

Row	Plant	Accession	2010 Forage preselect	9/27/2010 Ht rating 1=tall 3=short	2010 HV turf/short preselect
		ROW 22			
22	1	9094275		2	
22	2	9094275		2	
22	3	9094275		2	
22	1	9092245		2	
22	2	9092245		2	
22	3	9092245		3	
22	1	9094327		2	
22	2	9094327		2	
22	3	9094327		1	
22	1	9094288		2	
22	2	9094288		2	
22	3	9094288		2	
22	1	9094273		2	
22	2	9094273		3	
22	3	9094273		2	
22	1	9094263		2	
22	2	9094263		1	
22	3	9094263		1	
22	1	9092253		1	
22	2	9092253		1	
22	3	9092253		1	
22	1	9094309		2	
22	2	9094309	x	2	
22	3	9094309	x	2	
22	1	9094293		1	
22	2	9094293		1	
22	3	9094293		1	
		ROW 23			
23	1	9094261		3	
23	2	9094261		2	
23	3	9094261	x	1	
23	1	9094326		1	
23	2	9094326		1	
23	3	9094326	x	1	
23	1	9094267		2	
23	2	9094267		2	
23	3	9094267		dead	
23	1	9094294		2	
23	2	9094294		2	
23	3	9094294		3	
23	1	9094324		2	
23	2	9094324		2	
23	3	9094324		2	
23	1	9094304		2	
23	2	9094304		2	
23	3	9094304		2	
23	1	9094302		1	
23	2	9094302	x	1	

Row	Plant	Accession	2010 Forage preselect	9/27/2010 Ht rating 1=tall 3=short	2010 HV turf/short preselect
23	3	9094302	x	1	
23	1	9094284		1	
23	2	9094284		1	
23	3	9094284	x	1	
23	1	9094285		1	
23	2	9094285		2	
23	3	9094285		1	
		ROW 24			
24	1	9092248		3	
24	2	9092248		2	x
24	3	9092248		2	x
24	1	9094298		1	
24	2	9094298	x	1	
24	3	9094298	x	1	
24	1	9094286		1	
24	2	9094286		1	
24	3	9094286		1	
24	1	9094320		2	
24	2	9094320		2	
24	3	9094320		1	
24	1	9094313		1	
24	2	9094313	x	1	
24	3	9094313		2	
24	1	9094322		2	
24	2	9094322		2	
24	3	9094322		2	
24	1	9092250		2	
24	2	9092250		1	
24	3	9092250	x	1	
24	1	9092256		1	
24	2	9092256		1	
24	3	9092256		2	
24	1	9094291		1	
24	2	9094291		1	
24	3	9094291		1	
		ROW 25			
25	1	9094323		2	
25	2	9094323		2	
25	3	9094323		2	
25	1	9094328		2	
25	2	9094328		2	
25	3	9094328	x	1	
25	1	9094262		2	
25	2	9094262		1	
25	3	9094262		1	
25	1	9094303		1	
25	2	9094303	x	1	
25	3	9094303		2	
25	1	9092260		2	

Row	Plant	Accession	2010 Forage preselect	9/27/2010 Ht rating 1=tall 3=short	2010 HV turf/short preselect
25	2	9092260		2	
25	3	9092260		2	
25	1	9092251		2	
25	2	9092251		2	
25	3	9092251		2	
25	1	9094278		1	
25	2	9094278		1	
25	3	9094278		2	
25	1	9094277		3	
25	2	9094277		3	
25	3	9094277		3	x
25	1	9092246		2	
25	2	9092246		2	
25	3	9092246		3	
ROW 26					
26	1	9094318		2	
26	2	9094318		2	
26	3	9094318		2	
26	1	9094305		2	x
26	2	9094305		2	x
26	3	9094305		2	x
26	1	9094295		2	
26	2	9094295		1	
26	3	9094295		1	
26	1	9094274		2	
26	2	9094274		2	
26	3	9094274		2	
26	1	9094297		1	
26	2	9094297		1	
26	3	9094297		1	
26	1	9094268		2	
26	2	9094268		2	
26	3	9094268		3	
26	1	9094319		3	
26	2	9094319		3	
26	3	9094319		1	
26	1	9094299		2	
26	2	9094299		2	x
26	3	9094299		2	x
26	1	9094307	x	1	
26	2	9094307	x	1	
26	3	9094307		2	
ROW 27					
27	1	9092254		1	
27	2	9092254	x	1	
27	3	9092254	x	1	
27	1	9094300		3	
27	2	9094300		3	x
27	3	9094300		3	

Row	Plant	Accession	2010 Forage preselect	9/27/2010 Ht rating 1=tall 3=short	2010 HV turf/short preselect
27	1	Cuivre		2	
27	2	Cuivre		2	
27	3	Cuivre		2	
27	1	9094265		2	
27	2	9094265		1	
27	3	9094265		1	
27	1	9094264		2	
27	2	9094264		2	x
27	3	9094264		2	
27	1	EWP		1	
27	2	EWP		1	
27	3	EWP		1	
27	1	9094272		2	
27	2	9094272		1	
27	3	9094272		1	
27	1	9092249		2	
27	2	9092249		2	
27	3	9092249		2	
27	1	9094311		2	
27	2	9094311		1	
27	3	9094311		1	
		ROW 28			
28	1	9094270		2	
28	2	9094270		2	
28	3	9094270		2	
28	1	9092252	x	1	
28	2	9092252		1	
28	3	9092252	x	1	
28	1	9094301		1	
28	2	9094301		1	
28	3	9094301		1	
28	1	9094296		2	
28	2	9094296		2	
28	3	9094296		2	
28	1	9094269		1	
28	2	9094269		2	
28	3	9094269		2	
28	1	9094290		2	x
28	2	9094290		1	
28	3	9094290		2	

Table VW-3. Breeder Population selected from Initial Assembly

Acc.	State	County	# plants	Acc.	State	County	# plants	Acc.	State	County	# plants
9092247	MN	Clay	9	9092257	SD	Beadle	9	9092245	ND	Richland	1
9092250	MN	Aitkin	9	9094263	SD	Clay	4	9092246	ND	Cass	3
9092251	MN	Mille Lacs	9	9094264	SD	Clay	6	9092249	ND	Morton	9
9092253	MN	Aitkin	9	9094265	SD	Yankton	9	9092252	ND	Walsh	6
9092254	MN	Sherburne	9	9094266	SD	Union	7	9092259	ND	Emmons	8
9092255	MN	Sherburne	9	9094273	SD	Hanson	8	9092260	ND	Logan	7
9092256	MN	Aitkin	8	9094274	SD	Dewey	3	9094262	ND	Morton	8
9094261	MN	Rice	9	9094286	SD	Corson	9	9094267	ND	Oliver	8
9094277	MN	Polk	5	9094287	SD	Jackson	3	9094268	ND	Mercer	9
9094283	MN	Marshall	9	9094288	SD	Custer	7	9094269	ND	Mercer	9
9094284	MN	Marshall	9	9094289	SD	Harding	7	9094270	ND	Dunn	8
9094285	MN	Red Lake	3	9094290	SD	Shannon	8	9094271	ND	Stark	9
9094300	MN	Douglas	10	9094291	SD	Mellette	7	9094275	ND	Kidder	9
9094301	MN	Wadena	9	9094292	SD	Perkins	8	9094276	ND	Griggs	9
9094302	MN	Beltrami	9	9094293	SD	Fall River	9	9094278	ND	Nelson	9
9094303	MN	Norman	6	9094294	SD	Stanley	8	9094309	ND	McHenry	4
9094307	MN	Carlton	9	9094295	SD	Butte	9	9094310	ND	McLean	9
9094311	MN	Yellow Medicine	9	9094296	SD	Lawrence	9	9094323	ND	McKenzi	9
9094312	MN	LacQuiParle	8	9094297	SD	Roberts	8	9094324	ND	Golden V	9
9094313	MN	Sherburne	9	9094298	SD	Roberts	9	9094325	ND	Burleigh	9
9094316	MN	Pipestone	9	9094299	SD	Big Stone	2	9094327	ND	Renville	8
9094317	MN	Murray	2	9094304	SD	Hutchinson	2	9094328	ND	Bottineau	9
9094318	MN	Cottonwood	9	9094305	SD	Hand	4	9094329	ND	Mountra	6
9094319	MN	Redwood	9	9094308	SD	Grant	1	9094330	ND	Ward	2
9094320	MN	Lyon	6	9094314	SD	Brookings	6	EWP	ND		9
9094321	MN	Lincoln	8	9094315	SD	Minnehaha	6				
9094326	MN	Lac Qui Parle	9	9094322	SD	Marshall	3	Cuivre	MI		4

ACTIVE STUDIES - TECHNICAL REPORT 2011-2012

Study No. NDPMC-S-0704-CR

Study Name: Theodore Roosevelt National Park

Introduction: The National Park Service (NPS) has a need to preserve the native plant resources and revegetate disturbed park lands. The NPS requires that restoration of native plants will be accomplished using germplasm from populations as closely related genetically and ecologically as possible to the park populations. Quantities of native seed are needed to revegetate areas disturbed by construction activities for the proposed road rehabilitation project. The NPS has requested assistance from the Bismarck Plant Materials Center (PMC). The PMC has agreed to increase seed of six selected grass species collected at Theodore Roosevelt National Park. Technical assistance for planting, growing and cleaning of seed will also be provided to the park. The original interagency agreement was signed in May 2007, and expired in FY 2010. A new 2-year agreement was signed for the years covering FY 2011 and FY2012.

Targeted Species and Amounts:

Species	Common name	PLS pounds
<i>Nassella viridula</i>	green needlegrass	100
<i>Pascopyrum smithii</i>	western wheatgrass	200
<i>Elymus trachycaulus</i>	slender wheatgrass	100
<i>Bouteloua curtipendula</i>	sideoats grama	100
<i>Bouteloua gracilis</i>	blue grama	10
<i>Koeleria macrantha</i>	prairie junegrass	5

Accomplishments

2007: Seed was collected throughout the summer and fall by park staff. On July 26, 2007, Theodore Roosevelt National Park staff along with staff from the Natural Resources Conservation Service spent a day collecting seed at the park. Each of the species collected was assigned an accession number by PMC staff for identification and tracking purposes. Seed was cleaned by staff at the Bismarck PMC and samples were tested for purity and germination by the North Dakota State Seed Testing Laboratory located at Fargo, North Dakota. This seed was used to establish seed production fields at the PMC.

The green needlegrass was dormant planted on November 30, 2007. All other species were seeded in the spring of 2008. Following are details related to seed increase for each grass species. See Figure TR-1 for the field location map.

Seed Production and Distribution:

Species	Date Planted	Field Size (ac)	Seed Production (PLS lbs)					Seed Distribution to Park PLS lbs			***Remaining Inventory as of 3/1/2013 (PLS lbs)
			2008	2009	2010	2011	2012	2010	2011	2012	
Green needlegrass	11/30/07	0 (0.49)	No harvest	55.70	200.56	193.81	0.00	22.25	0.00	74.75	356.57
Western wheatgrass	05/01/08	0.57	No harvest	33.80	105.27	156.48	25.44	28.58	0.00	165.38	127.23
Slender wheatgrass	05/01/08	0 (0.5)	No harvest	208.30	306.90	222.00	0.00	22.95	0.00	132.35	587.90
Blue grama	06/10/08	0.30 (0.02)	1.5 pounds clean seed was bulked and tested with the 2009 harvest	6.40	1.98	7.42	29.43	1.20	0.00	0.00	43.18
Sideoats grama	06/10/08	0.30 (0.03)	3 pounds clean seed was bulked and tested with the 2009 harvest	23.90	7.20	10.13	34.55	19.39	0.00	0.00	49.40
Prairie junegrass*	05/22/08	0.20 (0.03)	No harvest	2.00	3.36	1.11	1.06	1.40	0.00	0.00	8.84

* 700 greenhouse plants planted

** Field size changed for these species in 2012. Number in parentheses indicate field size prior to 2012.

***Inventory remaining reflects the total amount of seed and has been updated with new germination tests on remaining lots of seed.

Green needlegrass: accession 9092171

Collected seed: Dirty weight - 4.4 lbs; bulk after cleaning - 2.8 lbs.

Seed cleaning: Debearder and a two-screen office fanning mill. The debearder speed was 160 rpm for 15 minutes. The office mill screen sizes were #9 round on top and a 1/22 bottom screen, with air 1/2 open.

Seed quality: Purity - 92%; Germination - 2%; Dormancy - 72%.

Seeding date: November 30, 2007. Due to high seed dormancy, seed was planted in late fall.

Site preparation: The field was cultivated and packed. No pre-plant herbicides were used. Field conditions were good with a firm seedbed. Soil moisture was dry at the surface and frozen below the 3-inch depth. Air temperatures were in the teens at the time of seeding.

Seeding: Seeding rate was approximately 50 seeds (bulk)/linear foot. Fourteen rows, approximately 424 feet long were planted on 42-inch row spacing (0.49 acre). A modified Truax grass drill was used for the planting. The seed was planted at a depth of 1/2 inch. The field received approximately 2 to 3 inches of snow cover a day after planting. The planting is located in panel G-4 on the southwest side.

Maintenance:

2008: The field was sprayed for weeds using Buctril™ herbicide at a rate of 2.0 pints per acre on June 19. Sterling™ herbicide at the rate of 1 pint per acre was applied to the field on June 27 and July 11. The field was hand rogued to remove weeds throughout the summer and irrigation water was applied. The field was fertilized on September 22, using 46-0-0 urea at a rate of 90 pounds of actual N per acre. A fall pre-emergent application of Trust™ herbicide was applied on October 9, at a rate of 1.5 pints per acre. The Trust™ herbicide was incorporated the same day using a 2-row tiller.

2009: The field was sprayed on May 9 with Curtail herbicide at a rate of 2 pints per acre. May 11, the field was walked and hand weeded. On June 4, the field was spot sprayed targeting Canada thistle. The field was sprayed with 2, 4-D herbicide at a rate of 2 pints per acre on August 4. The field was fertilized on September 17 with 46-0-0 urea at a rate of 44.5 pounds of actual N per acre. Curtail herbicide was applied on September 24, at a rate of 2 pints per acre.

2010: The field was sprayed with Trust™ herbicide on April 21 at a rate of 4 pints per acre. Curtail herbicide was applied on May 14 at a rate of 2 pints per acre for broadleaf weed control. The field was

hand weeded on May 17. Sterling Blue herbicide was applied on August 25 at a rate of 2 pints per acre for fall broadleaf weed control. A fall pre-emergence herbicide application of Trust was applied in September 21 at 4 pints per acre. Fifty pounds of actual nitrogen fertilizer was applied in the form of 46-0-0 urea on May 4. The field was not irrigated in 2010.

2011: The field was fertilized with 40 pounds of actual N per acre on April 28. On May 18 two pints of Curtail herbicide per acre and 2 pints of Class Act surfactant per acre were applied. The field was hand weeded on June 3. The field was harvested on July 7. On August 30 and September 29 the field was tilled between the rows. Fertilizer was applied on October 19 at a rate of 40 pounds of Actual N per acre in using 46-0-0 urea. On November 4 the field was sprayed with Trust herbicide using 4 pints per acre.

2012: Seed production goals were met in 2011. The field was removed on May 10 with the application of glyphosate.

Plant Performance:

2008: Seedlings were slow to emerge. A fair stand was present by mid-summer. Weed pressure was a problem during the summer and herbicide applications were necessary. Seed continued to germinate and the stand improved by late summer.

2009: The field established well and a good stand was evident at the end of the growing season.

2010: The stand has become well established and seed production should be good for the next few years.

2011: A good stand

2012: Field removed

Harvest and cleaning:

2008: No seed was harvested in 2008.

2009: Seed was straight combined on July 2 using a Massey Ferguson model 17 combine. The combine cylinder speed was set at 1200 rpm, cylinder clearance was 7 millimeters and the fan wind speed set on 4 (mostly closed) with a wind board adjustment of 2 (placing air flow on the front of the sieve). The chaffer sieve was ½ inch open and the finishing sieve was set using the medium hole. The combine was operated at 1 mph. The bulk dirty weight of the seed was 94 pounds. The seed was cleaned using a debearder and fanning mill. The seed was debearded for 15 minutes at 235 rpm to break up and remove awns. The seed was then run through a 3-screen model 334 Clipper Fanning Mill using a number 9 screen size for the first screen, a number 8 screen size for the second screen and a 1/22 screen size for the third screen. The air speed was 225 rpm and the side plate setting was open. The seed was run through the fanning mill twice resulting in 64 bulk clean pounds. The seed was sent in for seed tests and test results showed 99.99% purity, 7% germination and 80% dormant seed. The total clean seed amount was 55.7 pounds PLS.

2010: Seed was straight combined on July 1 using a Massey Ferguson model 17 combine. Combine settings were set the same as in 2009. The bulk dirty weight of the harvested seed was 253 pounds. The seed was cleaned using the same cleaning protocol as in 2009. The clean seed amount was 218 bulk clean pounds. Seed was sent in for tests resulting in 98.73% purity, 13% germination and 80% dormant seed. Pure live seed total was 200.2 pounds.

2011: The field was harvested on July 7. A MF 17 combine was used to straight combine the field. The cylinder speed was set at 1200 rpms and cylinder clearance of 7 mm. Fan wind speed was set on 2 and the fan board adjustment was 4. The finishing sieve was set ½ inch open. The seed was cleaned using a debearder and fanning mill. The seed was debearded for 15 minutes at 235 rpm to break up and remove awns. The seed was then run through a 3-screen model 334 Clipper Fanning Mill using a number 9 screen size for the first screen, a number 8 screen size for the second screen and a 1/22 screen size for the third screen. The air speed was 225 rpm and the side plate setting was open. The seed was run through the fanning mill twice. The clean seed amount was 193 PLS pounds.

2012: No harvest

Western wheatgrass: accession 9092172

Collected seed: Dirty weight - 17.68 lbs; bulk after cleaning - 3.25 lbs.

Seed cleaning: Hammermill and a two-screen office fanning mill. The material was hammermilled twice to break the seed from the stem. A ¼-inch screen was used the first run and a 3/16-inch screen was used for the second run. The office mill screen sizes were 1/12 x 1/2 on top and a blank screen on the bottom for the

first run. The second run used a 1/14 x 1/4 screen on top and a blank on the bottom. The side plate setting was 1/4 open on both runs.

Seed quality: Purity - 92.24%; Germination - 87%; Dormancy - 0%.

Seeding date: May 1, 2008

Site preparation: The seedbed was prepared by cultivating twice with a 6-foot S-tine cultivator and packing twice with a Brillion packer.

Seeding: A seeding rate of 40 PLS per linear foot was used for planting the field. Eight rows, approximately 894 feet long, were planted using a modified Truax grass drill with 42-inch row spacing (.57 acre). The seed was planted at a depth of 1/2 inch. The field is located in panel G-4 of the PMC.

Maintenance:

2008: The field was sprayed for weeds using Buctril™ herbicide at a rate of 1.5 pints per acre on June 10. Sterling™ herbicide at the rate of 1 pint per acre was applied to the field on June 27, and again on July 11. The field was hand rogued to remove weeds throughout the summer and irrigation water was applied. The field was fertilized on September 22, using 46-0-0 urea at a rate of 90 pounds of actual N per acre. A fall pre-emergent application of Trust™ herbicide was applied on October 9, at a rate of 1.5 pints per acre. The field was lightly tilled the same day using a 2-row tiller to incorporate the Trust™ herbicide.

2009: The field was sprayed on May 7 with Curtail herbicide at a rate of 2 pints/acre. The field was hand weeded on May 11 and 28. On August 14, the field was sprayed with 2 pints/acre of 2,4-D herbicide. On September 17, urea fertilizer was applied at a rate of 44.5 pounds of actual N/acre. On September 24, Curtail herbicide was applied at a rate of 2 pints/acre for broadleaf weed control.

2010: The field was sprayed with Trust™ herbicide on April 21 at a rate of 4 pints per acre. The field was hand weeded on May 17. A fall pre-emergence herbicide application of Trust was applied in September 21 at 4 pints per acre. Fifty pounds of actual nitrogen fertilizer was applied in the form of 46-0-0 urea on May 4. The field was not irrigated in 2010.

2011: The field was fertilized with 40 pounds of actual N per acre on April 29. On May 18 two pints of Curtail herbicide per acre and 2 pints of Class Act surfactant per acre were applied. The field was harvested on August 3. Fertilizer was applied on October 19 at a rate of 40 pounds of Actual N per acre in using 46-0-0 urea. On November 4 the field was sprayed with Trust herbicide using a rate of 4 pints per acre.

2012: The field was fertilized with 40 pounds of actual N per acre on April 25. On April 26 Prowl herbicide was applied at 3 quarts per acre. The field was harvested on July 19. On October 2 Trust herbicide was applied at 4 quarts per acre.

Plant performance:

2008: The seedlings emerged very well and a good stand was established by mid- summer.

2009: Excellent growth that produced a large amount of biomass. A fair seed crop appeared to be developing by mid-summer but poor seed fill was apparent during harvest and a fair seed crop resulted. The field is a mix of western wheatgrass and slender wheatgrass. This mixture was due to both species being collected together in the initial park collection and planted to establish the seed increase field at the PMC. The mixture has been discussed among both parties and it was decided to maintain the field as a mix.

2010: The stand is well established and plant vigor remains high.

2011: The field has grown solid and seed production is declining.

2012: Seed production has declined and a new field should be started if the agreement continues.

Harvest and cleaning:

2008: No seed was harvested in 2008.

2009: Seed was straight combined with a Massey Ferguson model 17 on July 28. The stand was mostly lodged and made combining difficult. The combine was set with a cylinder speed of 950 rpm. A cylinder clearance of 7 millimeters, a fan wind speed of 1(closed) and a wind board adjustment of 4 (wind placed near the front of sieve). The chaffer sieve adjustment was 1/2 inch open and a medium hole finishing sieve was used. The combine was operated at 1 mile per hour. The bulk dirty weight of the seed was 344 pounds. The seed was cleaned through a 3 screen Model 334 Clipper Fanning Mill using a 1/14x1/2 screen size for the first screen, a 1/16 x 1/4 screen for the second and a 9 triangle for the third screen. The 9 triangle screen was covered with plastic except for the bottom 3-inches of the screen.

The air speed was 258 rpm with the side plate open. The seed was run a second time through the fanning mill using the same settings. The bulk clean seed amount was 87 total pounds. The field has a

percentage of slender wheatgrass mixed in with the western wheatgrass. The slender was misidentified during collection and included in the western wheatgrass seed. It was decided to leave the field as a mixture and harvest accordingly. The seed was sent in for seed tests and test results showed western wheatgrass with a 65.86 % purity, 59% germination and 0% dormant. The slender wheatgrass has a 25.46% purity, 96% germination and 0% dormant seed. The total clean seed amount was 33.8 pounds PLS of western wheatgrass and 21.2 pounds PLS of slender wheatgrass. The total western/slender wheatgrass mix is 55 pounds PLS.

2010: Seed was straight combined on August 4 using a Massey Ferguson model 17 combine. Combine settings were set the same as in 2009. The bulk dirty weight of the harvested seed was 316 pounds. The seed was cleaned using a Clipper 29D four screen fanning mill. The clean seed amount was 121 bulk clean pounds. Seed was sent in for tests resulting in 92.70% purity, 94% germination and 0% dormant seed. Pure live seed total was 105.4 pounds.

2011: The field was straight combined on August 3 using a MF 17 combine. The combine was set with a cylinder speed of 1000 rpm. A cylinder clearance of 8 millimeters, a fan wind speed of 1(closed) and a wind board adjustment of 4 (wind placed near the front of sieve). The chaffer sieve adjustment was ½ inch open and a medium hole finishing sieve was used. The combine was operated at 1 mile per hour. The seed was cleaned through a 4 screen Clipper Fanning Mill using a 1/13x1/2 screen size for the first screen, a 1/14 x ½ screen for the second screen, a 1/14x ¼ screen for the third and a 9 triangle for the third screen. The 9 triangle screen was covered with plastic except for the bottom 2-inches of the screen. The air speed was 232 rpm. The top door was set with a 4 inch opening. The shaker speed was 400 rpm. The seed was run a second time through the fanning mill using the same settings. The clean seed amount was 156.48 PLS pounds.

2012: The field was straight combined on August 19 using a MF 17 combine. The combine was set with a cylinder speed of 1000 rpm. A cylinder clearance of 8 millimeters, a fan wind speed of 1(closed) and a wind board adjustment of 4 (wind placed near the front of sieve). The chaffer sieve adjustment was ½ inch open and a medium hole finishing sieve was used. The combine was operated at 1 mile per hour. The seed was cleaned through a 3 screen Clipper Fanning Mill using a 11 screen size for the first screen, a 1/14 x ½ screen for the second screen, a 9 triangle for the third screen. The 9 triangle screen was covered with plastic except for the bottom 1-inch of the screen. The air speed was 243 rpm. The side plate was open. The clean seed amount was 25.44 PLS pounds.

Slender wheatgrass: accession 9092175

Collected seed: Dirty weight - 3.59 lbs; bulk after cleaning - 854 grams.

Seed cleaning: Hammermill and two-screen office fanning mill. The seed was initially hammermilled twice to separate seed from the stems. A ¼-inch screen size and a slow speed were used. The material was fed at full rate. The seed was then run twice through an office mill. The first run used a number 12 screen size for the top screen and a blank screen was used on the bottom. A number 10 screen size was used as the top screen with a blank screen being used on the bottom for the second run. The side plate setting on the office mill was ¼ open for both runs.

Seed quality: Purity – 98.19%; Germination - 89%; Dormancy - 0%.

Seeding date: May 1, 2008

Site preparation: The seedbed was prepared by working twice with a 6-foot S-tine cultivator and packing twice with a Brillion packer.

Seeding: Seed was planted at a rate of 33 PLS per linear foot and a depth of ½ inch. Fourteen rows, approximately 443 feet long, were planted using a modified Truax grass drill with 42-inch row spacing (.50 acre). The field is located in panel G-4 of the PMC.

Maintenance:

2008: The field was sprayed for weeds using Buctril™ herbicide at a rate of 1.5 pints per acre on June 10. Sterling™ herbicide at the rate of 1 pint per acre was applied to the field on June 27, and again on July 11. The field was hand rogued to remove weeds throughout the summer and irrigation water was applied. The field was fertilized on September 22, using 46-0-0 urea at a rate of 90 pounds of actual N per acre. A fall pre-emergent application of Trust™ herbicide was applied on October 9, at a rate of 1.5 pints per acre. The Trust™ herbicide was incorporated the same day using a 2-row tiller.

2009: The field was sprayed on May 7 with Curtail herbicide at a rate of 2 pints/acre. The field was hand weeded on May 11. The field was walked and spot sprayed for Canada thistle on June 4. On August 14, the field was sprayed with 2,4-D herbicide at a rate of 2 pints per acre. On September 17,

urea fertilizer was applied at a rate of 44.5 pounds of actual N/acre. On September 24, Curtail herbicide was applied at a rate of 2 pints/acre for broadleaf weed control.

2010: The field was sprayed with Trust™ herbicide on April 21 at a rate of 4 pints per acre. The field was hand weeded on May 17. Sterling Blue herbicide was applied on August 25 at a rate of 2 pints per acre to control broadleaf weeds. A fall pre-emergence herbicide application of Trust was applied in September 21 at 4 pints per acre. Fifty pounds of actual nitrogen fertilizer was applied in the form of 46-0-0 urea on May 4. The field was not irrigated in 2010.

2011: The field was fertilized with 40 pounds of actual N per acre on April 28. Weeds were spot sprayed on May 2. On May 18 two pints of Curtail herbicide per acre and 2 pints of Class Act surfactant per acre were applied. The field was harvested on July 26. On August 29 and September 26 the field was rototilled between rows. Fertilizer was applied on October 19 at a rate of 40 pounds of Actual N per acre in using 46-0-0 urea. On November 4 the field was sprayed with Trust herbicide using a rate of 4 pints per acre.

2012: Seed production goals were met in 2011. The field was sprayed with glyphosate on May 10 to kill the field.

Plant performance:

2008: The seedlings emerged very well and a good stand was established by mid-summer.

2009: The stand is well established and produced a large amount of biomass and seed. It was observed that a majority of the field contained slender wheatgrass with a percentage of the stand being made up of thickspike wheatgrass. This mixture was most likely the result of the two species being collected together during the initial park collection. It was discussed and agreed to manage the field as a mixture of thickspike wheatgrass and slender wheatgrass.

2010: The field is well established.

2011: Good stand.

2012: Field removed.

Harvest and cleaning:

2008: No seed was harvested in 2008.

2009: The field was straight combined on July 22 using a Massey Ferguson model 17 combine. The cylinder speed was set at 950 rpm with a 7 millimeter cylinder clearance. The fan wind speed was set on the first hole setting (closed) and the fan wind board was set on the 4th hole setting (wind directed to the front of the sieve). The chaffer sieve was set at ½ inch open and medium hole finishing sieve was used. The combine was operated at 1 mile per hour. The bulk dirty weight of the seed was 365 pounds. The seed was cleaned through a 3-screen Model 334 Clipper Fanning Mill using a number 13 screen for the first screen, a number 11 for the second, and a 9 triangle screen that was covered with plastic sheeting except for the bottom 3 inches which were left open for the third screen. The air speed was run at 300 rpm with the side plate open. The seed was run a second time through the fanning mill using a number 11 for the first screen a number 10 for the second screen and a 9 triangle with 3-inch opening for the third screen the air speed was increased to 340 rpm. The bulk clean seed amount was 229 pounds. The seed was sent in for seed tests and test results showed 92.82% purity, 98% germination and 0% dormant seed for the thickspike wheatgrass and 5.57% purity, 97% germination and 0% dormant seed for the slender wheatgrass. The total clean seed amount was 208.3 pounds PLS of thickspike wheatgrass and 12.4 pounds of slender wheatgrass. The total thickspike/slender mix was 220.7 pounds PLS.

2010: The field was straight combined on July 22 using a Massey Ferguson model 17 combine. The cylinder speed was set at 1000 rpm with a 7 millimeter cylinder clearance. The fan wind speed was set on the first hole setting (closed) and the fan wind board was set on the 4th hole setting (wind directed to the front of the sieve). The chaffer sieve was set at ½ inch open and medium hole finishing sieve was used. The combine was operated at 1 mile per hour. The bulk dirty weight of the seed was 429 pounds. The seed was cleaned through a 3-screen Model 334 Clipper Fanning Mill. The bulk clean seed amount was 341 pounds. The seed was sent in for seed tests and test results showed 94.55% purity, 95% germination and 0% dormant seed. The total clean seed was 306.3 pounds PLS.

2011: The field was straight combined on July 26 using a Massey Ferguson model 17 combine. The cylinder speed was set at 1000 rpm with a 7 millimeter cylinder clearance. The fan wind speed was set on the first hole setting (closed) and the fan wind board was set on the 4th hole setting (wind directed to the front of the sieve). The chaffer sieve was set at ½ inch open and medium hole finishing sieve was

used. The combine was operated at 1 mile per hour. The seed was cleaned through a 3-screen Model 334 Clipper Fanning Mill. The total clean seed was 222 pounds PLS.

2012: No harvest. Field was removed.

Blue grama: accession 9092173

Collected seed: Dirty weight - 1.4 lbs; bulk after cleaning - 188.1 grams

Seed cleaning: Debearder and two-screen office fanning mill. The seed was processed through a debearder for 10 minutes before being run through a small office mill. The top screen was a number 10 and the bottom screen was a blank. The seed was then hand screened to remove the larger sticks. A sample was sent to the seed testing lab for germination and purity results.

Seed quality: Purity – 35.72%; Germination - 78%; Dormancy - 1%.

Seeding date: June 10, 2008

Site preparation: The seedbed was prepared by working twice with a 6-foot S-tine cultivator and packing twice with a Brillion packer.

Seeding: Seed was planted at a rate of 40 PLS per linear foot and a depth of ½ inch. Due to the limited seed amount of blue grama, a plot drill was used to plant a 6-foot x 158-foot bed (0.02 acres) in panel G-4 of the PMC. The seed was planted at a depth of ½ inch.

Maintenance:

2008: Sterling™ herbicide at the rate of 1 pint per acre was applied to the field on June 27. The field was hand rogued to remove weeds throughout the summer and irrigation water was applied. The field was not fertilized in 2008.

2009: The field was sprayed on May 7 with Curtail herbicide at a rate of 2 pints per acre. The field was fertilized with 46-0-0 urea at a rate of 44.5 pounds of actual N on May 7. The field was hand weeded throughout the summer. A fall application of 46-0-0 urea fertilizer was applied on September 17 at a rate of 44.5 pounds of actual N. On September 24, the field was sprayed with Curtail herbicide at a rate of 2 pints per acre.

2010: The field was sprayed with Trust™ herbicide on April 21 at a rate of 4 pints per acre. The field was hand weeded on May 17. 2,4D herbicide was applied on June 9 at a rate of 2 pints per acre to control broadleaf weeds. Fifty pounds of actual nitrogen fertilizer was applied in the form of 46-0-0 urea on May 4. The field was not irrigated in 2010.

2011: The field was burned on April 13 to remove residue and promote seed production. On April 26 Atrazine was applied at a 2 pint per acre rate. The field was spot sprayed on May 2. Forty pounds of actual nitrogen fertilizer was applied in the form of 46-0-0 urea on May 2. On May 18 the field was sprayed with Curtail herbicide at a rate of 2 pints per acre and Class Act surfactant at 2 pints per acre for broadleaf weed control. The field was harvested on August 25. The field was not irrigated in 2011.

2012: The field was burned on April 25. On May 1 Forty pounds of actual nitrogen fertilizer was applied in the form of 46-0-0 urea on May 1. Atrazine was applied at 2 pints per acre on May 1. The field size was increased from 0.03 acre to 0.3 acre on May 9. On June 15 Sterling Blue herbicide was applied to the new field at a rate of 1 pint per acre. The new field was hand weeded on July 4 and mowed on July 16 for weed control. The old field was harvested on August 7. The new field produced seed also and was harvested later that fall. The field was fertilized with 40 pounds actual nitrogen on September 28. The field was irrigated with ½ inch of water in 2012.

Plant performance:

2008: The seedlings were slow to establish and a fair stand was observed by the end of the summer.

2009: The stand developed very well in 2009 and a solid stand was achieved by the end of the growing season.

2010: A good stand with high plant vigor.

2011: The stand is well established.

2012: The existing field continues to do well. A new field was planted on May 9. This seeding established well. Viable seed was produced in the first year of the planting and a harvest was made.

Harvest and cleaning:

2008: A few plants produced mature seed and were hand stripped by PMC staff. Three pounds of dirty seed were harvested amounting to 1.5 pounds after cleaning. The seed will be bulked together with the 2009 harvest and tested at that time.

2009: Seed was straight combined with a Wintersteiger plot combine on August 27. The combine was set with a cylinder speed of 700 rpm, cylinder clearance was set with the front adjustment at 1

millimeter and the back adjustment was set at 2 millimeters. The fan wind speed was set at 650 rpm and the fan door was closed. The large-hole chaffer sieve was used and the adjustable grain sieve was set ¼ inch open. The bulk dirty weight of the seed was 13 pounds. The seed was run through a debearder for 10 minutes and then run through an office mill. A number 10 screen was used for the first screen and a blank for the second screen. The seed was run a second time through the office mill using the same settings. The bulk clean seed amount was 6 pounds. The seed was bulked with the 1.5 pounds of 2008 harvest and sent in for seed tests. The test results are a purity of 94.65%, germination of 90% and 0% dormant seed. The total clean seed amount (2008 and 2009) was 6.4 pounds PLS.

2010: Seed was straight combined with a Wintersteiger plot combine on August 27. The combine was set with a cylinder speed of 650 rpm, cylinder clearance was set with the front adjustment at 1 millimeter and the back adjustment was set at 2 millimeters. The fan wind speed was set at 650 rpm and the fan door was closed. The large-hole chaffer sieve was used and the adjustable grain sieve was set ¼ inch open. The bulk dirty weight of the seed was 22 pounds. The seed was run through a debearder for 10 minutes and then run through an office mill. The bulk clean seed amount was 5.5 pounds. The seed was sent in for seed tests resulting in a purity of 56.01%, germination of 64% and 0% dormant seed. The total clean seed amount was 2 pounds PLS.

2011: The field was straight combined on August 25 using a MF-17 combine. The combine was set with a cylinder speed of 1200 rpm, cylinder clearance was set at 8mm. The fan wind speed was set at 1 fan door was closed. The medium hole chaffer sieve was used and the adjustable grain sieve was set ¼ inch open. The seed was run through a debearder for 10 minutes and then run through an office mill. The clean seed amount was 7.42 PLS pounds.

2012: The field was straight combined with a Wintersteiger plot combine on August 22. The combine was set with a cylinder speed of 1200 rpm, cylinder clearance was set with the front adjustment at 1 millimeter and the back adjustment was set at 1 millimeter. The fan wind speed was set at 680 rpm and the fan door was closed. The large-hole chaffer sieve was used and the adjustable grain sieve was set 1/2 inch open. The seed was run through a debearder for 10 minutes at 292 rpm. It was then run through a 4 screen Clipper 29D fanning mill using a number 12 screen for the first screen, number 11 for the second screen, number 8 with ½ inch open for the third and a number 9 tri with a 1 inch opening for the fourth screen the air speed was 157 rpm. And the shaker speed was 400 rpm. The top door was open. The seed was then run through a cylinder indent cleaner with a feeder speed of 30, cylinder speed of 50 and a number 3 indent cylinder. The total clean seed amount was 29.43 pounds PLS.

Sideoats grama: accession 9092174

Collected seed: Dirty weight - 3.6 lbs; bulk after cleaning - 2.8 lbs

Seed cleaning: Two-screen office fanning mill. The top screen was a number 20 screen size and the bottom screen was a blank. The side plate air setting ¼ open. A sample of the seed was tested for purity and germination.

Seed quality: Purity – 61.62%; Germination - 5%; Dormancy - 24%.

Seeding date: June 10, 2008

Site preparation: The seedbed was prepared by working twice with a 6-foot S-tine cultivator and packing twice with a Brillion packer.

Seeding: Seed was planted at a rate of 30 PLS per linear foot and a depth of ½ inch. Due to the limited seed amount of sideoats grama, a plot drill was used to plant a 6-foot x 189-foot bed (0.03 acres) in panel G-4 of the PMC.

Maintenance:

2008: Sterling™ herbicide was applied on June 27, at the rate of 1 pint per acre. The field was hand rogued to remove weeds throughout the summer and irrigation water was applied. The field was not fertilized in 2008.

2009: The field was hand weeded throughout the summer. Urea fertilizer (46-0-0) was applied at a rate of 44.5 pounds of actual N on September 17. The field was sprayed with 2 pints per acre of Curtail herbicide on September 24.

2010: The field was sprayed with Trust™ herbicide on April 21 at a rate of 4 pints per acre. The field was hand weeded on May 17. 2,4D herbicide was applied on June 9 at a rate of 2 pints per acre to control broadleaf weeds. Fifty pounds of actual nitrogen fertilizer was applied in the form of 46-0-0 urea on May 4. The field was not irrigated in 2010.

2011: The field was burned on April 13 to remove residue and promote seed production. On April 26 Atrazine was applied at a 2 pint per acre rate. The field was spot sprayed on May 2. Forty pounds of actual nitrogen fertilizer was applied in the form of 46-0-0 urea on May 2. On May 18 the field was sprayed with Curtail herbicide at a rate of 2 pints per acre and Class Act surfactant at 2 pints per acre for broadleaf weed control. The field was harvested on August 17. The field was not irrigated in 2011.

2012: The field was burned on April 25. On May 1 Forty pounds of actual nitrogen fertilizer was applied in the form of 46-0-0 urea on May 1. Atrazine was applied at a 2 pint per acre rate on May 1. The field size was increased from 0.02 acre to 0.3 acre on May 9. On June 15 Sterling Blue herbicide was applied to the new field at a rate of 2 pints per acre. The new field was mowed on July 10. The old field was harvested on August 7. The new field produced seed also and was harvested later that fall. The field was irrigated with ½ inch of water on August 24.

Plant performance:

2008: The seedlings were slow to establish and a fair stand was observed by the end of the summer. A few of the plants produced seed by the end of the growing season.

2009: The stand was well established by the end of the 2009 growing season.

2010: The field has become well established.

2011: Good stand.

2012: The existing field has a good stand established. The new field established well. Seed was produced and harvested that fall.

Harvest and cleaning:

2008: Seed was hand stripped from the plants and produced 4.5 pounds of dirty seed. The seed has been cleaned and 3 pounds of clean seed resulted.

2009: The field was straight combined on September 4 using a Wintersteiger plot combine. The combine was set with a cylinder speed of 850 rpm, cylinder clearance was set with the front adjustment at 1 millimeter and the back adjustment was set at 2 millimeters. The fan wind speed was set at 670 rpm and the fan door was 1 inch open. The large hole chaffer sieve was used and the adjustable grain sieve was set ¾ inch open. The bulk dirty weight of the seed was 40 pounds. The seed was cleaned through a 3-screen Model 334 Clipper Fanning Mill using a number 14 screen for the first screen, a number 13 for the second, and a 9 triangle screen that was covered with plastic sheeting except for the bottom 3 inches which were left open for the third screen. The air speed was run at 268 rpm with the side plate open. The bulk clean seed amount was 27 pounds. The seed was sent in for tests which resulted in 98.43% purity, 90% germination and 0% dormant seed. The total clean seed amount was 23.9 pounds PLS.

2010: The field was straight combined on September 4 using a Wintersteiger plot combine. The combine was set with a cylinder speed of 850 rpm, cylinder clearance was set with the front adjustment at 1 millimeter and the back adjustment was set at 2 millimeters. The fan wind speed was set at 670 rpm and the fan door was 1 inch open. The large hole chaffer sieve was used and the adjustable grain sieve was set ¾ inch open. The bulk dirty weight of the seed was 27 pounds. The seed was cleaned through a 3-screen Model 334 Clipper Fanning Mill using a number 14 screen for the first screen, a number 13 for the second, and a 9 triangle screen that was covered with plastic sheeting except for the bottom 3 inches which were left open for the third screen. The air speed was run at 268 rpm with the side plate open. The bulk clean seed amount was 12 pounds. The seed was sent in for tests which resulted in 96.25% purity, 58% germination and 4% dormant seed. The total clean seed amount was 7.2 pounds PLS.

2011: The field was straight combined on August 17 using a Wintersteiger plot combine. The combine was set with a cylinder speed of 850 rpm, cylinder clearance was set with the front adjustment at 1 millimeter and the back adjustment was set at 1 millimeter. The fan wind speed was set at 670 rpm and the fan door was 1 inch open. The large hole chaffer sieve was used and the adjustable grain sieve was set ¾ inch open. The seed was cleaned through a 3-screen Model 334 Clipper Fanning Mill using a number 14 screen for the first screen, a number 13 for the second, and a 9 triangle screen that was covered with plastic sheeting except for the bottom 3 inches which were left open for the third screen. The air speed was run at 268 rpm with the side plate open. The total clean seed amount was 7.13 PLS pounds.

2012: The field was straight combined with a Wintersteiger plot combine on August 7. The combine was set with a cylinder speed of 1000 rpm, cylinder clearance was set with the front and back adjustment at 1 millimeter. The fan wind speed was set at 660 rpm and the fan door was ½ open. The

large-hole chaffer sieve was used and the adjustable grain sieve was set 1/2 inch open. The seed was cleaned through a 3-screen Model 334 Clipper Fanning Mill using a number 14 screen for the first screen, a number 13 for the second, and a 9 triangle screen that was covered with plastic sheeting except for the bottom 3 inches which were left open for the third screen. The air speed was run at 268 rpm with the side plate open. The total clean seed amount was 34.55 PLS pounds.

Prairie junegrass: accession 9092176

Collected seed: Dirty weight - 0.98 lbs; bulk after cleaning - 56.6 grams.

Seed cleaning: Hammermill and two screen office fanning mill. The materials was hammermilled twice using a 3/32 screen size for both runs and a slow speed at full rate of feed. The seed was run through a two-screen office mill twice using a 1/12 top screen and a blank bottom screen for both runs. The air speed (rpm) was slow and the side plate setting was closed.

Seed quality: No seed tests were done due to the limited amount of seed.

Seeding date: Seedlings were transplanted into the field on May 22, 2008.

Site preparation: The bed was prepared by working twice with a 6-foot S-tine cultivator and packing twice with a Brillion packer. A specialized tool bar with two chisel shovels spaced 42 inches apart was used to make 2 rows for transplanting.

Seeding: Seed was very limited so seed was started in flats in the greenhouse on February 14. Plantlets were transplanted from the flats into cone-tainers when they were approximately 1/2 inch tall. The plants were allowed to grow in the greenhouse until May 12, when they were moved to the lathhouse to harden off for transplanting into the field. Approximately 700 plants were transplanted into two 348-foot long rows in panel G-4 of the PMC.

Maintenance:

2008: Sterling™ herbicide was applied on June 27 at the rate of 1 pint per acre. The field was hand rogued to remove weeds throughout the summer. Irrigation water was applied on May 23, the day after planting, to water in the transplants and increase the survival. Irrigation water continued to be applied during the growing season. No fertilizer was applied in 2008.

2009: The field was sprayed on May 7 using Curtail herbicide at a rate of 2 pints/acre. Urea fertilizer, 46-0-0 was applied on May 7 at a rate of 44.5 pounds of actual N/acre. The field was roto-tilled on June 2. The field was sprayed on August 14 with 2,4-D herbicide at a rate of 2 pints per acre. On September 17, urea fertilizer, 46-0-0, was applied at a rate of 44.5 pounds of actual N/acre. On September 24, Curtail herbicide was applied at a rate of 2 pints/acre.

2010: The field was sprayed with Trust™ herbicide on April 21 at a rate of 4 pints per acre. The field was hand weeded on May 17. Fifty pounds of actual nitrogen fertilizer was applied in the form of 46-0-0 urea on May 4. The field was not irrigated in 2010.

2011: The field was fertilized with 40 pounds of actual N per acre on April 28. On May 18 two pints of Curtail herbicide per acre and 2 pints of Class Act surfactant per acre were applied. On July 15 the field was hand weeded. The field was harvested on July 22. On August 30 the field was tilled between rows. Fertilizer was applied on October 19 at a rate of 40 pounds of actual N per acre in using 46-0-0 urea. On November 4 the field was sprayed with Trust herbicide using a rate of 4 pints per acre.

2012: The field size was increased from 0.03 acre to 0.2 acre on May 12. On June 15, Sterling Blue at a rate of 1 pint per acre was applied for broadleaf weed control. On July 12, seed was harvested by hand clipping the seed heads. On July 16, the new field was mowed. Fertilizer was applied on September 28 at a rate of 40 pounds of actual N per acre in using 46-0-0 urea. On November 2, the field was sprayed with Trust herbicide using a rate of 4 quarts per acre.

Plant performance:

2008: Survival of the junegrass plants was excellent.

2009: The small field has become well established.

2010: The field is well established and individual plants are robust.

2011: Plant vigor is declining.

2012: New field is developing slowly due to weed pressure and dry conditions. Old field continues to decline in vigor.

Harvest and cleaning:

2008: No seed was harvested in 2008.

2009: The field was straight combined on July 17 using a Wintersteiger plot combine. The combine was set with a cylinder speed of 700 rpm, cylinder clearance was set with the front adjustment at 1

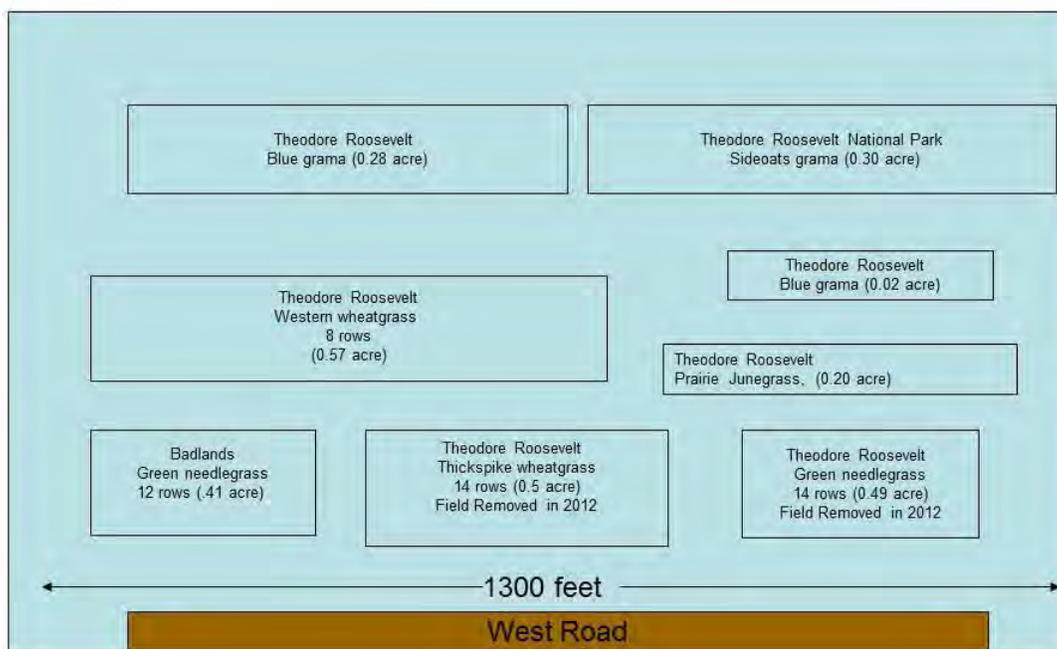
millimeter and the back adjustment was set at 1 millimeter. The fan wind speed was set at 600 rpm and the fan door was closed. The large-hole chaffer sieve was used and the adjustable grain sieve was set ½ inch open. The bulk dirty weight of the seed was 46 pounds. The seed was cleaned through a small 2 screen office mill using a number 7 screen for the first screen and a blank screen for the second screen. Air speed was slow and the side plate was closed. The seed was run a second time changing the screen sizes to a 1/13 screen for the first and a 1/25 for the second screen. The bulk clean seed amount was 5 pounds. The seed was sent in for tests which resulted in 62.07% purity, 64% germination and 0% dormant seed. The total clean seed amount was 2 pounds PLS.

2010: The field was straight combined on July 17 using a Wintersteiger plot combine. The combine was set with a cylinder speed of 915 rpm, cylinder clearance was set with the front adjustment at 1 millimeter and the back adjustment was set at 1 millimeter. The fan wind speed was set at 665 rpm and the fan door was closed. The large-hole chaffer sieve was used and the adjustable grain sieve was set 3/8 inch open. The bulk dirty weight of the seed was 12 pounds. The seed was cleaned through a small 2 screen office mill using a number 7 screen for the first screen and a blank screen for the second screen. Air speed was slow and the side plate was closed. The bulk clean seed amount was 7 pounds. The seed was sent in for tests which resulted in 69.22% purity, 70% germination and 0% dormant seed. The total clean seed amount was 3.4 pounds PLS.

2011: The field was straight combined on July 22 using a Wintersteiger plot combine. The combine was set with a cylinder speed of 915 rpm, cylinder clearance was set with the front adjustment at 1 millimeter and the back adjustment was set at 1 millimeter. The fan wind speed was set at 665 rpm and the fan door was closed. The large-hole chaffer sieve was used and the adjustable grain sieve was set 3/8 inch open. The seed was cleaned through a small 2 screen office mill using a number 7 screen for the first screen and a blank screen for the second screen. Air speed was slow and the side plate was closed. The total clean seed amount was 1.1 pounds PLS.

2012: The field was harvested by hand due to very few seed heads in the field on July 12. The seed was cleaned through a small 2 screen office mill using a number 7 screen for the first screen and a blank screen for the second screen. Air speed was slow and the side plate was closed. The total clean seed amount was 1.06 pounds PLS.

Figure TR-1. Field Map, Panel G-4.



ACTIVE STUDIES - TECHNICAL REPORT 2011-2012

Study No. NDPMC-S-0705-CR

Study Name: Badlands National Park

Introduction: The National Park Service (NPS) has a need to preserve the native plant resources and revegetate disturbed park lands. The NPS requires that restoration of native plants will be accomplished using germplasm from populations as closely related genetically and ecologically as possible to the park populations. Quantities of native seed are needed to revegetate areas disturbed by construction activities for the proposed road rehabilitation project. The NPS has requested assistance from the Bismarck Plant Materials Center (PMC). The PMC has agreed to increase seed of five selected grass species collected at Badlands National Park. Technical assistance for planting, growing and cleaning of seed will also be provided to the park. The first interagency agreement was signed in May 2007 and expired in FY 2010. The agreement has been extended and expires the end of FY2013.

Targeted Species and Amounts:

Species	Common name	PLS pounds
<i>Nassella viridula</i>	green needlegrass	100
<i>Pascopyrum smithii</i>	western wheatgrass	200
<i>Elymus trachycaulus</i>	slender wheatgrass	100
<i>Bouteloua gracilis</i>	blue grama	10
<i>Sporobolus cryptandrus</i>	sand dropseed	5

Accomplishments

Seed was collected throughout the summer and fall of 2007 by park staff. On July 24, 2007, Badlands National Park staff along with staff from the Natural Resources Conservation Service spent a day collecting seed at the park. All seed was inventoried at the Bismarck PMC and was cleaned, tested and used in the planting of seed increase fields at the PMC. Each species of seed was assigned an accession number (identification number). Seed germination and purity was tested by the North Dakota State Seed Department. The green needlegrass was dormant planted on November 30, 2007. All of the other species except sand dropseed were seeded in the spring of 2008. Seed from the sand dropseed was planted in the PMC greenhouse in February 2008. Approximately 700 sand dropseed plants were propagated for establishing the seed production field. Following are details related to seed increase activities for each grass species. See Table BA-1 for cumulative information on target species collected at Badlands National Park. See Figure BA-1 and BA-2 for field location maps.

Table BA-1. Seed Production and Distribution

Species	Date Planted	Field Size (ac)	Seed Production					Seed Distribution to the Park			**Remaining Inventory as of 3/14/13
			(PLS pounds)					(PLS pounds)			(PLS lbs)
			2008	2009	2010	2011	2012	2010	2011	2012	
Green needlegrass	11/30/07	0.41	No harvest	63.2	264.0	142.5	39.8	22.02	1.80	90.3	387.0
Western wheatgrass	05/06/08	1.50	No harvest	307.0	202.7	98.2	0.0	229.11	12.00	250.3	98.2
Slender wheatgrass	05/06/08	0(0.95)*	5 lbs uncleaned (mixed and cleaned with 2010 harvest)	362.0	333.1	205.6	0.0	77.48	4.50	277.3	569.5
Blue grama	06/10/08	0.3(0.04)*	No harvest	7.6	1.3	4.4	19.6	2.73	0.30	4.3	24.9
Sand dropseed	05/22/08	0.1(0.03)*	mixed with 2009 harvest	4.1	1.4	2.9	14.9	0.38	0.08	4.3	18.5

* Field size changed for these species in 2012. Number in parentheses indicate field size prior to 2012.
 **Inventory remaining reflects the total amount of seed and has been updated with new germination tests on remaining lots of seed.

Green needlegrass: accession 9092167

Seed cleaning of collected seed: Debearder and a two-screen office fanning mill. The debearder speed was 160 rpm for 15 minutes. The office mill screen sizes were #9 round on top and a 1/22 bottom screen, with air 1/2 open.

Seeding date: November 30, 2007. Due to high seed dormancy, seed was planted in late fall.

Site preparation: The field was cultivated and packed. No preplant herbicides were used. Field conditions were good with a firm seedbed. Soil moisture was dry at the surface and frozen below the 3-inch depth. Air temperatures were in the teens at the time of seeding.

Seeding: The field was dormant seeded on November 30, 2007. The seeding rate was approximately 50 seeds (bulk)/linear foot. Twelve rows, approximately 424 feet long, were planted using a modified Truax grass drill with 42-inch row spacing (0.41 acre). The seed was planted at a depth of 1/2 inch. The field received approximately 2 to 3 inches of snow cover the day after planting. The planting is located in panel G-4 on the southwest side.

Maintenance:

2008: On May 27, the field was sprayed for weeds using Buctril™ herbicide at a rate of 1.5 pints per acre. On June 27 and July 11, Sterling™ herbicide at the rate of 1 pint per acre was applied to the field. The field was hand rogued to remove weeds throughout the summer. Irrigation water was applied during the growing season. The field was fertilized on September 22, using 46-0-0 urea at a rate of 90 pounds of actual N per acre. A fall pre-emergent application of Trust™ herbicide was applied on October 9, at a rate of 1.5 pints per acre. The field was then lightly tilled the same day using a 2-row tiller to incorporate the Trust™ herbicide.

2009: The field was sprayed on May 7 using Curtail herbicide at a rate of 2 pints/acre. The field was hand weeded on May 17 and spot sprayed for Canada thistle on June 4. On August 14, the field was sprayed with 2 pints/acre of 2,4-D herbicide. On September 17, urea fertilizer was applied at a rate of 44.5 pounds of actual N/acre. On September 24, Curtail herbicide was applied at a rate of 2 pints/acre for broadleaf weed control.

2010: The field was sprayed with Trust™ herbicide on April 21 at a rate of 4 pints per acre. Curtail herbicide was applied on May 14 at a rate of 3 pints per acre for broadleaf weed control. The field was hand weeded on May 17. A fall pre-emergent herbicide application of Trust was applied in September 21 at 4 pints per acre. Fifty pounds of actual nitrogen fertilizer was applied in the form of 46-0-0 urea on May 4. The field was not irrigated in 2010.

2011: On April 28, the field was fertilized with 40 pounds of actual N in the form of 46-0-0 urea. On May 18, Curtail herbicide was applied at a 2 pint per acre rate. Class Act surfactant was applied at a 2 pint per acre rate. Weeds were removed by hand on June 3. The field was harvested on July 13. The field was rototilled between rows on August 30 and September 15 for weed control. On October 19 the field was fertilized with 40 pounds of

actual N. using 46-0-0 granular urea. Trust herbicide was applied for preemergent weed control at a rate of 4 pints per acre on November 4. The field was not irrigated in 2011.

2012: The field was tilled between rows on April 26. Prowl Herbicide was applied at a rate of 3 quarts per acre. Weeds were hand rogued on June 6. The field was harvested on June 25. On July 22, the field was tilled between rows for weed control. The field was irrigated with ½ inch of water on August 24. Forty pounds of actual nitrogen was applied using 46-0-0 urea on September 28. A preemergent application of Trust herbicide was applied on October 1.

Plant performance:

2008: Seedlings were slow to emerge. A fair stand was present by mid-summer. Weeds presented a problem during the summer and herbicide applications were necessary to reduce the weed pressure. Seed continued to germinate and the stand improved by late summer.

2009: A good stand had established by the end of 2009.

2010: The stand is well established.

2011: Excellent stand.

2012: Excellent stand.

Harvest and cleaning:

2008: No harvest was done in 2008.

2009: Seed was straight combined on July 2 using a Kincaid model 2065 combine. The combine cylinder speed was set at 1200 rpm, cylinder clearance was 7 millimeters and the fan wind speed set on 4 (mostly closed) with a wind board adjustment of 2 (places air flow on the front of the sieve). The chaffer sieve was ½ inch open and the finishing sieve was set using the medium hole. The combine was operated at 1 mph. The bulk dirty weight of the seed was 123 pounds. The seed was cleaned using a debearder and fanning mill. The seed was debearded for 15 minutes at 235 rpm to break up and remove awns. The seed was then run through a 3-screen model 334 Clipper Fanning Mill using a number 9 screen size for the first screen, a number 8 screen size for the second screen and a 1/22 screen size for the third screen. The air speed was 225 rpms and the side plate setting was open. The seed was run through the fanning mill twice resulting in 79 bulk clean pounds. The seed was sent in for seed tests and test results showed 99.69% purity, 8% germination and 72% dormant seed. The total clean seed amount was 63.2 pounds PLS.

2010: Seed was straight combined on July 1 using a Massey Ferguson model 17 combine. Combine settings were set the same as in 2009. The bulk dirty weight of the harvested seed was 333 pounds. The seed was cleaned using the same cleaning protocol as in 2009. The clean seed amount was 281 bulk clean pounds. Seed was sent in for tests resulting in a 99.96% purity, 4% germination and 90% dormant seed. The total pounds of pure live seed was 264 pounds.

2011: Harvested on July 13. Cleaned seed amount was 142.5 pounds PLS.

2012: The field was harvested on June 25. Seed was cleaned and tested and resulted in 39.8 PLS pounds.

Western wheatgrass: accession 9092165

Seed cleaning of collected seed: Hammermill and a two-screen office fanning mill. The material was first run through a hammermill to break the seed from the stem. The material was hammered milled twice. The first run was with a ¼-inch screen size. The second run was through a 3/16-inch screen. The office mill screen sizes were 1/12 x 1/2 on top and a blank screen on the bottom for the first run. The second run used a 1/14 x 1/4 screen on top and a blank on the bottom. The side plate setting was ¼ open on both runs.

Seeding date: May 6, 2008

Site preparation: The seedbed was prepared by working twice with a 6-foot S-tine cultivator and packing twice with a Brillion packer.

Seeding: A seeding rate of 35 PLS per linear foot was used for planting the field. Fourteen rows, approximately 1,290 feet long, were planted using a modified Truax grass drill with 42-inch row spacing (1.5 acres). The seed was planted at a depth of 1/2 inch. The field is located in panel G-2 of the PMC.

Maintenance:

2008: On May 27 and again on June 19, the field was sprayed for weeds using Buctril™ herbicide at a rate of 1.5 pints per acre. On June 27, and again on July 11, Sterling™ herbicide at the rate of 1 pint per acre was applied to the field. The field was hand rogued to remove weeds throughout the summer. Irrigation water was applied during the growing season. On September 3, the field was sprayed with 2 pints per acre of 2,4-D herbicide for fall emerging weeds. The field was fertilized on September 22, using 46-0-0 urea at a rate of 90 pounds of actual N per acre. A fall pre-emergent application of Trust™ herbicide was applied on October 9, at a rate of 1.5 pints per acre. The field was lightly tilled the same day using a 2-row tiller to incorporate the Trust™ herbicide.

2009: The field was sprayed on May 7 with Curtail herbicide at a rate of 2 pints/acre. The field was hand weeded on May 11 and 28. The field was walked and spot sprayed for Canada thistle on June 4. On August 14, the field was sprayed with 2 pints/acre of 2,4-D herbicide. On September 17, urea fertilizer was applied at a rate of 44.5 pounds of actual N/acre. On September 24, Curtail herbicide was applied at a rate of 2 pints/acre for broadleaf weed control.

2010: The field was sprayed with Trust™ herbicide on April 21 at a rate of 4 pints per acre. The field was hand weeded on May 17 and 19. A fall pre-emergence herbicide application of Trust was applied in September 21 at 4 pints per acre. Fifty pounds of actual nitrogen fertilizer was applied in the form of 46-0-0 urea on May 4. The field was not irrigated in 2010.

2011: The field was fertilized on April 29 with 40 pounds actual N. Two pints per acre of Curtail herbicide and 2 pints per acre of Class Act surfactant were applied on May 18. The field was harvested August 9. On October 20 forty pounds of actual N was applied. On November 4 Trust herbicide was applied at 4 pints per acre rate.

2012: On April 26 Prowl herbicide at the rate of 3 quarts per acre were applied. The field was not harvested and residue was mowed on July 27. Fertilizer was applied at 40 pounds actual nitrogen on September 28.

Application of Trust herbicide was applied on October 2 at a rate of 4 quarts per acre to control preemergent weeds the following spring.

Plant performance:

2008: The seedlings emerged very well and a good stand was established by mid-summer.

2009: A very good stand has established. The stand produced a very heavy seed crop that lodged by the end of summer.

2010: The stand is well established.

2011: The field was heavily lodged by harvest and combining could only be done going in a south direction. The field had heavy growth but only fair seed production.

2012: No seed production but good vegetative growth. The field has grown solid and needs to be reestablished in the future.

Harvest and cleaning:

2008: No harvest was done in 2008.

2009: Seed was straight combined with a Massey Ferguson model 17 on August 14. The combine was set with a cylinder speed of 900 rpms. A cylinder clearance of 8 millimeters, a fan wind speed of 1 (closed) and a wind board adjustment of 4 (wind placed near the front of sieve). The chaffer sieve adjustment was ½ inch open and a medium hole finishing sieve was used. The combine was operated at 1 1/2 miles per hour. The bulk dirty weight of the seed was 801 pounds. The seed was cleaned through a 3 screen Model 334 Clipper Fanning Mill using a 1/14x1/2 screen size for the first screen, a 1/16 x ¼ screen for the second and a 9 triangle for the third screen. The 9 triangle screen was covered with plastic except for the bottom 1 inch of the screen. The air speed was 258 rpm with the side plate open. The seed was run a second time through the fanning mill using the same settings. The bulk clean seed amount was 393 pounds. The seed was sent in for seed tests and test results showed 94.12% purity, 83% germination and 0% dormant seed. The total clean seed amount was 307 pounds PLS.

2010: Seed was straight combined on August 5 using a Kincaid Model 2065 combine. Combine settings were cylinder speed 950 rpm, cylinder clearance 8mm, fan wind speed of 1 (closed) and a wind board adjustment of 4 (wind placed near the front of sieve). The chaffer sieve adjustment was ½ inch open and a medium hole finishing sieve was used. The combine was operated at 1 1/2 miles per hour. The bulk dirty weight of the harvested seed was 678 pounds. The seed was cleaned using a Clipper 29D four screen fanning mill. The clean seed amount was 233 bulk clean pounds. Seed was sent in for tests resulting in a 93.49% purity, 91% germination and 2% dormant seed. Pure live seed totaled 202.6 pounds.

2011: The field was swathed on August 8 due to severe lodging. It was combined with a MF-17 combine on August 9. Combine settings were similar to past years. Seed was cleaned and tested for purity and germination resulting in 98.2 pounds of PLS.

2012: No harvest.

Slender wheatgrass: accession 9092166

Seed cleaning of collected seed:

Hammermill and two-screen office fanning mill. The seed was initially run through a hammermill to separate seed from the stems. A ¼-inch screen size was used on the hammermill and a slow speed was used. The material was fed at full rate. The material was hammermilled twice. The seed was then run through an office mill twice. The first run used a number 12 screen size for the top screen and a blank screen was used on the bottom. A number 10

screen size was used as the top screen with a blank screen being used on the bottom for the second run. The side plate setting on the office mill was $\frac{1}{4}$ open for both runs.

Seeding date: May 6, 2008

Site preparation: The seedbed was worked twice with a 6-foot S-tine cultivator and packing twice with a Brillion packer.

Seeding: A seeding rate of 25 PLS per linear foot was used for planting the field. Six rows, approximately 1,039 feet long, were planted using a modified Truax grass drill with 42-inch row spacing (0.95 acre). The seed was planted at a depth of $\frac{1}{2}$ inch. The field is located in panel G-2 of the PMC.

Maintenance:

2008: On May 27 and again on June 19, the field was sprayed for weeds using Buctril™ herbicide at a rate of 1.5 pints per acre. On June 27 and again on July 11, Sterling™ herbicide at the rate of 1 pint per acre was applied to the field. The field was hand rogued to remove weeds throughout the summer. Irrigation water was applied during the growing season. The field was fertilized on September 22, using 46-0-0 urea at a rate of 90 pounds of actual N per acre. A fall pre-emergent application of Trust™ herbicide was applied on October 9, at a rate of 1.5 pints per acre. The field was then lightly tilled the same day using a 2-row tiller to incorporate the Trust™ herbicide.

2009: The field was sprayed on May 7 with Curtail herbicide at a rate of 2 pints/acre. The field was hand weeded on May 28. The field was walked and spot sprayed for Canada thistle on June 4. On September 17, urea fertilizer was applied at a rate of 44.5 pounds of actual N/acre. On September 24, Curtail herbicide was applied at a rate of 2 pints/acre for broadleaf weed control.

2010: The field was sprayed with Trust™ herbicide on April 21 at a rate of 4 pints per acre. The field was hand weeded on May 10. A fall pre-emergence herbicide application of Trust was applied in September 21 at 4 pints per acre. Fifty pounds of actual nitrogen fertilizer was applied in the form of 46-0-0 urea on May 4. The field was not irrigated in 2010.

2011: On April 26, Trust herbicide was applied at 2 pints per acre. Fertilizer was applied at a rate of 40 pounds actual nitrogen per acre. Broadleaf weed control applied on May 18 using 2 pints Curtail and 2 pints Class Act surfactant. The field was harvested on July 20. The field was tilled between rows on August 8 and again on October 17. Fertilizer was applied on October 18 using 40 pounds actual urea per acre. On November 4, the pre-emergent herbicide Trust was applied at 4 pints per acre.

2012: The field was discontinued and was sprayed with glyphosate on May 10 using a rate of 2 pints per acre tank mixed with 2 pints Class Act surfactant. The residue was mowed on June 2.

Plant performance:

2008: A stand was well established by the end of the growing season. A fair amount of the plants matured and produced seed.

2009: The stand established very well and produced large amounts of vegetation and a fair seed crop.

2010: The stand is well established.

2011: The field had good growth and continues to produce good seed harvests.

2012: The seed production goals for slender wheatgrass have been met and the field has been removed.

Harvest and cleaning:

2008: Twenty-eight pounds of dirty seed was harvested on September 15. A Wintersteiger plot combine was used for the harvest. The combine settings were as follows: cylinder speed was 850 rpm, cylinder clearance was 1 millimeter for the front and rear. Fan speed was set at 670 rpm. A large hole chaffer sieve was used and the finishing sieve was set at the sixth hole from the rear of the combine. The seed was cleaned using a 3-screen Clipper 334 Fanning Mill. The seed was run through the fanning mill twice using the same settings. The number 1 screen was a $\frac{1}{14} \times \frac{1}{2}$ inch slotted hole screen. The number 2 screen was a $\frac{1}{4}$ inch \times $\frac{1}{16}$ inch slotted hole screen. The number three screen was a 9 triangle with a 1 inch opening. Air speed was set at 248 rpm with the side plate setting open. The seed was finished using a cylinder indent cleaner with a 3-0 screen size and a cylinder speed of 50 rpm. The feeder speed was set at a slow setting (6) and the feeder capacity set at $1 \frac{1}{2}$ inch open. Five pounds of clean bulk seed resulted. This seed will be bulked with the 2010 harvest and tested for a purity and germination.

2009: The field was straight combined on July 22 using a Massey Ferguson model 17 combine. The cylinder speed was set at 950 rpm with a 8 millimeter cylinder clearance. The fan wind speed was set on the first hole setting (closed) and the fan wind board was set on the 4th hole setting (wind directed to the front of the sieve). The chaffer sieve was set at $\frac{3}{4}$ inch open and medium hole finishing sieve was used. The combine was operated at $1 \frac{1}{2}$ miles per hour. The bulk dirty weight of the seed was 510 pounds. The seed was cleaned through a 3-screen Model 334 Clipper Fanning Mill using a number 13 screen for the first screen, a number 11 for the

second, and a 9 triangle screen that was covered with plastic sheeting except for the bottom 3 inches which were left open for the third screen. The air speed was run at 300 rpm with the side plate open. The seed was run a second time through the fanning mill using a number 11 for the first screen a number 10 for the second screen and a 9 triangle with 3-inch opening for the third screen the air speed was increased to 340 rpm. The bulk clean seed amount was 405 pounds. The seed was sent in for seed tests and test results showed 99.28% purity, 90% germination and 0% dormant seed. The total clean seed amount was 362 pounds PLS. The 5 pounds of 2008 harvest was not mixed with the 2009 harvest. It will be mixed with the 2010 harvest and tested.

2010: The field was straight combined on July 16 using a Kincaid 2065 combine. The cylinder speed was set at 950 rpm with an 8 millimeter cylinder clearance. The fan wind speed was set on the first hole setting (closed) and the fan wind board was set on the 4th hole setting (wind directed to the front of the sieve). The chaffer sieve was set at 3/4 inch open and medium hole finishing sieve was used. The combine was operated at 1 1/2 miles per hour. The bulk dirty weight of the seed was 401 pounds. The seed was cleaned through a 3-screen Model 334 Clipper Fanning Mill using a number 1/14x1/2 screen for the first screen, a number 1/14 x1/4 for the second, and a 9 triangle screen that was covered with plastic sheeting except for the bottom 3 inches which were left open for the third screen. The air speed was run at 258 rpm with the side plate open. The seed was run through a second time using the same settings. The bulk clean seed amount 347 pounds. The seed was sent in for seed tests and test results showed 98.88% purity, 97% germination and 0% dormant seed. The total clean seed amount was 347.2 pounds PLS.

2011: Harvest was done on July 20 by straight combining using similar settings to past years. Seed was cleaned using the same protocol from previous years. Seed was cleaned tested and resulted in 205.6 pounds PLS.

2012: The field was not harvested in 2012. Production goals have been met and the field was removed.

Blue grama: accession 9092168

Seed cleaning of collected seed: Debearder and two-screen office fanning mill. The seed was processed through a debearder for 10 minutes before being run through a small office mill. The screens used were a number 10 screen for the top screen and a blank screen on the bottom. The seed was then hand screened to remove the larger sticks. A sample was sent to the seed testing lab and is awaiting germination and purity results.

Seeding date: June 10, 2008

Site preparation: The seedbed was prepared by working twice with a 6-foot S-tine cultivator and packing twice with a Brillion packer.

Seeding: A seeding rate of 70 PLS seeds per linear foot was used for planting the field. Due to the limited amount of seed a plot drill was used to plant a 6 foot x 270 foot bed (0.04 acres). The seed was planted at a depth of 1/2 inch. The bed is located in panel G-2 of the PMC.

Maintenance:

2008: On June 19, the field was sprayed for weeds using Buctril™ herbicide at a rate of 1.5 pints per acre. On June 27, and again on July 11, Sterling™ herbicide at the rate of 1 pint per acre was applied to the field. The field was hand rogued to remove weeds throughout the summer. Irrigation water was applied during the growing season. No fertilizer was applied to the field in 2008.

2009: The field was sprayed on May 7 using Curtail herbicide at a rate of 2 pints/acre. Urea fertilizer, 46-0-0 was applied on May 7 at a rate of 44.5 pounds of actual N/acre. The field was hand weeded on May 28. On September 17, urea fertilizer, 46-0-0 was applied at a rate of 44.5 pounds of actual N/acre. On September 24, Trust herbicide was applied at a rate of 1.5 pints/acre.

2010: The field was sprayed with 2 pints of 2,4-D herbicide on June 9. The field was hand weeded July 7. Fifty pounds of actual nitrogen fertilizer was applied in the form of 46-0-0 urea on May 4.

2011: On April 13, the field was burned. A herbicide application of 2 pints of Atrazine per acre was applied on April 26. The field was spot sprayed on May 2 using glyphosate to control cool-season grasses. Fertilizer was applied at a rate of 40 pounds per acre actual nitrogen using 46-0-0 urea. On May 18, broadleaf weeds were sprayed using 2 pints per acre of Curtail herbicide and 2 pints per acre Class Act surfactant.

2012: Residue was burned on April 25. On May 1 fertilizer was applied at a rate of 55 pounds of actual N per acre and the field was sprayed with 2 pints of Atrazine per acre. On May 9 the field size was increased from 0.04 acre to 0.3 acre. The field was seeded using a modified Truax drill with Kincaid cones. Seedbed was black and packed. The field could be rowed by early June. Weeds were controlled on June 15 using Sterling Blue herbicide at a rate of 1 pint per acre. The new seeding was mowed for weeds on July 10. The field was fertilized on September 28 with 40 pounds of actual N per acre.

Plant performance:

2008: Seedling emergence was slow and a fair stand was evident at the end of the growing season.

2009: By the end of the growing season the small field was well established.

2010: The field is established.

2011: Good stand but poor seed production.

2012: There is a good stand on the old field. The newly planted field planted in May is doing well and was harvested for seed.

Harvest and cleaning:

2008: A limited amount of ripe seed was hand stripped from the plants resulting in 2 pounds of dirty seed. The seed has been cleaned and 206 grams of clean seed were obtained. Due to the limited amount of seed, a 2008 seed test will not be done. The 206 grams will be bulked together with the 2009 harvest and tested at that time.

2009: Seed was straight combined with a Wintersteiger plot combine on September 4. The combine was set with a cylinder speed of 700 rpm, cylinder clearance was set with the front adjustment at 1 millimeter and the back adjustment was set at 2 millimeters. The fan wind speed was set at 650 rpm and the fan door was closed. The large hole chaffer sieve was used and the adjustable grain sieve was set ¼ inch open. The bulk dirty weight of the seed was 18 pounds. The seed was cleaned using a hand screen, then debarbed, hand screened a second time and then run through an office mill. The seed was run through an indent cleaner for the final cleaning. The bulk clean seed amount was 8.45 pounds. The seed was sent in for seed tests which resulting in a purity of 96.39%, germination of 85% and 8% dormant seed. The total clean seed amount was 7.6 pounds PLS.

2010: Seed was straight combined with a Wintersteiger plot combine on September 8. The combine was set with a cylinder speed of 950 rpm, cylinder clearance was set with the front adjustment at 1 millimeter and the back adjustment was set at 1 millimeters. The fan wind speed was set at 650 rpm and the fan door was closed. The large hole chaffer sieve was used and the adjustable grain sieve was set ¼ inch open. The bulk dirty weight of the seed was 16 pounds. The seed was debarbed, and then run through an office mill. The screen size was a number 12 for the first screen and a blank for the second screen. The air speed was very light and the side plate setting was ¼ inch open. The seed was run through the office fanning mill a second time using a number 9 screen on top and a blank for the second screen. All the machine settings were kept the same except the side plate setting was changed to ½ inch open. The bulk clean seed amount was 4.5 pounds. The seed was sent in for seed tests, resulting in a purity of 37.92%, germination of 74% and 1% dormant seed. The total clean seed amount was 1.3 pounds PLS.

2011: Straight combined on August 25 using a MF-17 combine. Combine settings were; cylinder speed 1200 rpm, cylinder clearance 8mm, fan wind speed 1, Fan door adjustment was on 4. The chaffer sieve was 1/3 of an inch open. A medium hole finishing sieve was used. Ground speed was 1½ miles per hour. Seed was cleaned using previous year settings. Seed was sent in for germination and purity tests and resulted in 4.65 pounds PLS.

2012: The field was straight combined using a Wintersteiger combine. A cylinder speed of 1000 rpm with cylinder clearance set at F1 and R1. Fan wind speed was 650 rpm. The fan door was closed. The large hole chaffer sieve was used and the finishing sieve was ½ inch open. Ground speed was 1 mile per hour. A later harvest of the newly planted field was also taken on August 8th. The seed was mixed together and cleaned using a 4 screen fanning mill. Screen sizes were a number 12 for the first screen, a number 11 for the second screen, a number 8 with ½ of the screen open for the third screen and a 9 tri with 1 inch open for the fourth screen. Air speed was 157 rpm, the top door was removed, and the shaker speed was set at 400 rpm. Seed was sent in for purity and germination tests and resulted in 19.59 pounds.

Sand dropseed: accession 9092169

Seed cleaning of collected seed: The park seed was separated from the stems by hand stripping. The seed was then hand screened using a pan screen to separate sticks and chaff out.

Seeding date: Approximately 700 greenhouse grown plants were transplanted to the field on May 22, 2008.

Site preparation: The bed was prepared by working twice with a 6-foot S-tine cultivator and packing twice with a Brillion packer. A specialized tool bar with two chisel shovels spaced 42 inches apart was used to make 2 rows for transplanting.

Seeding: Due to the limited amount of seed available, plants were grown in the greenhouse and then planted into the field. Seed was planted in flats in the greenhouse on February 14. Plantlets were transplanted from the flats into containers when they were approximately ½ inch tall. The plants were allowed to grow in the greenhouse until May 12, when they were moved to the lathhouse to harden off for transplanting into the field. Approximately 700 plants were transplanted into two 283 foot long rows in panel G-2 of the PMC.

Maintenance:

2008: The plants were irrigated on May 23, the day after planting, to optimize transplant survival. On May 27 and again on June 19, the field was sprayed for weeds using Buctril™ herbicide at a rate of 1.5 pints per acre. On June 27, and again on July 11, Sterling™ herbicide at the rate of 1 pint per acre was applied to the field. The field was hand rogued to remove weeds throughout the summer. Irrigation water was applied during the growing season. No fertilizer was applied to the field in 2008.

2009: The field was sprayed on May 7 using Curtail herbicide at a rate of 2 pints/acre. Urea fertilizer, 46-0-0 was applied on May 7 at a rate of 44.5 pounds of actual N/acre. The field was hand weeded on May 28. On September 17, urea fertilizer, 46-0-0 was applied at a rate of 44.5 pounds of actual N/acre. On September 24, Trust herbicide was applied at a rate of 1.5 pints/acre.

2010: The field was sprayed June 9 with 2,4-D at a rate of 2 pints per acre for broadleaf weed control. The field was hand weeded on July 7. Fifty pounds of actual nitrogen fertilizer was applied in the form of 46-0-0 urea on May 4. The field was not irrigated in 2010.

2011: The two rows were burned on April 13. The field was fertilized on May 2 with 40 pounds of actual N per acre. Weeds were spot sprayed on May 2. On May 18, two pints of Curtail herbicide tank mixed with 2 pints of Class Act were applied for broadleaf weed control. The field was harvested on August 8. On August 30 the rows were tilled between. Fertilizer was applied at a rate of 40 pounds per acre actual nitrogen. On November 4, four pints per acre of Trust herbicide were applied to the field.

2012: On May 1 the field was fertilized with 25 pounds of actual N. Two pints per acre of Atrazine herbicide was applied on May 1. The field size was increased on May 10 from 0.03 acre to 0.1 acre. Seed was broadcast on a clean soil surface. On June 13, Sterling Blue herbicide was applied at a rate of 1 pint per acre for broadleaf weed control. On July 10, weeds were mowed on the new field. The old field was harvested on July 16.

Plant performance:

2008: Survival was excellent and most of the plants produced viable seed the first year.

2009: The small field established well and a good seed crop was harvested.

2010: The field is well established.

2011: Good growth and seed production.

2012: Seed production was fair on the old stand. The new seeding was slow to germinate due to dry conditions. By the end of the summer a fair stand had established and a small amount of seed was harvested by the end of the summer.

Harvest and cleaning:

2008: A small harvest of 5 pounds dirty seed was taken using a Wintersteiger plot combine. The combine was set with a cylinder speed of 700 rpm, cylinder clearance of 1 millimeter in front and 1 millimeter in the rear. The fan speed was set at 600 rpm with the fan door closed. The large hole chaffer sieve was used and the adjustable grain sieve was ½ inch open. The 5 pounds of 2008 harvested seed was cleaned using a hammermill to breakup stems and remove seed from the seed heads. The hammermill was run at a slow speed with a full rate of feed. The screen size was a 1/8 inch hole. The seed was then run across an office mill twice using the same settings, a 1/12 inch screen size for the first screen and a blank for the number 2 screen. The air speed was slow, side plate setting was closed. The seed was finished using an indent cleaner with a 2.75 inch screen. Three pounds of clean seed resulted. The 3 pounds of clean seed was not sent in for testing and will be bulked with the 2009 harvest and tested.

2009: Seed was straight combined with a Wintersteiger plot combine on July 31 when a majority of the seed was mature. The combine was set with a cylinder speed of 700 rpm, cylinder clearance 1 millimeter in the front and 2 millimeters in the back, fan wind speed of 650 rpm and the fan door was closed. A large hole chaffer sieve was used. The adjustable grain sieve was set at ½ inch open. The bulk dirty weight of the seed was 6 pounds. The seed was cleaned using a small office mill with the first screen a 1/13 and the second screen a blank. The seed was run a second time changing the number one screen to a 1/15 screen and all other adjustments were left the same. The bulk clean seed amount was 5.5 pounds. The 5.5 pounds of 2009 seed was bulked with the 3 pounds of 2008 harvest and sent in for seed tests. Tests are pending at this time.

2010: Seed was straight combined with a Wintersteiger plot combine on August 28 some seed had already shattered from the plants. The combine was set with a cylinder speed of 750 rpm, cylinder clearance 1 millimeter in the front and 1 millimeter in the back, fan wind speed of 650 rpm and the fan door was closed. A large hole chaffer sieve was used. The adjustable grain sieve was set at 3/8 inch open. The bulk dirty weight of the seed was 10 pounds. The seed was cleaned using a hand screen with 8/64 round hole screen size. A small office mill was used next with the first screen a 1/16 and the second screen a blank. The bulk clean seed amount

was 7 pounds. The seed was sent in for seed tests which resulting in a purity of 96.47%, germination of 32% and 56% dormant seed. The total clean seed amount was 5.9 pounds PLS.

2011: The field was straight combined using a Wintersteiger plot combine on August 8. The combine was set with a cylinder speed of 600 rpm. Cylinder clearance was set on F1 and R1. The fan wind speed was 650 rpm and the fan door was 1 inch open. A large hole chaffer sieve was used and the finishing sieve was 1/3 inch open. The seed was cleaned using an office fanning mill and indent cleaner. The clean seed amount was 2.9 pounds PLS.

2012: The field was straight combined using a Wintersteiger plot combine. The cylinder speed was 960 rpm and cylinder clearance was set at F1 and R1. The fan wind speed was 650 rpm. A medium holed chaffer sieve was used. The finishing sieve was set 3/8 inch open. The seed was cleaned using a small office mill and indent cleaner. Clean seed was 14.9 pounds PLS.

Figure BA-1. Field map, G-2.

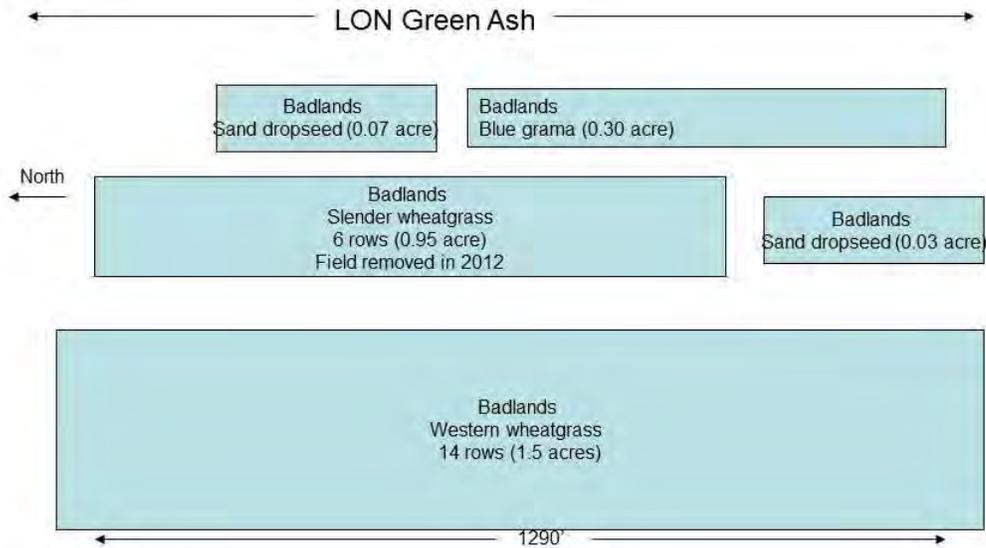
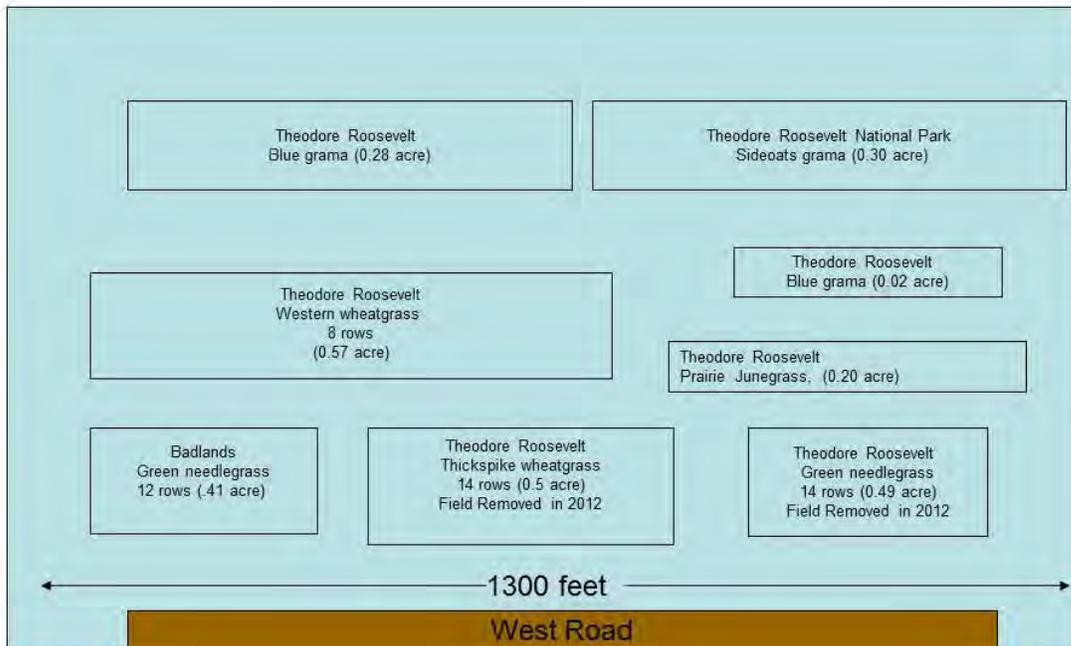


Figure BA-2. Field map, G-4.



ACTIVE STUDIES - TECHNICAL REPORT 2011-2012

Study No. NDPMC-S-1004-CR

Study Name: Grand Teton National Park

Introduction: The Natural Resources Conservation Service (NRCS), Plant Materials Center (PMC), Bismarck, North Dakota, entered into an interagency agreement on June 1, 2010, with the National Park Service (NPS), Grand Teton National Park (GTNP) to grow and produce seed of bluebunch wheatgrass (*Pseudoroegneria spicata*), slender wheatgrass (*Elymus trachycaulus*) and mountain brome (*Bromus marginatus*) for use in revegetating Kelly Hay Fields. Fields were established at the PMC in 2010 with seed originating from GTNP. Seed was harvested from these fields in 2011 and 2012 and distributed to GTNP for reclamation activities.

Targeted Species and Goaled Seed Amounts

Species	Common Name	PLS Pounds
<i>Pseudoroegneria spicata</i>	bluebunch wheatgrass	100
<i>Elymus trachycaulus</i>	slender wheatgrass	600
<i>Bromus marginatus</i>	mountain brome	400

Accomplishments: Seed from GTNP was given to the Bismarck PMC to establish seed production fields at the PMC. The PMC assigned each species an accession number and recorded it in a seed inventory database.

Accession Number	Species	Seeding Date	Seeding Rate (PLS lb/ac)	Field Size (ac)
9094354	mountain brome	5/26/2010	10.0	1.0
9094353	slender wheatgrass	5/26/2010	5.5	1.0
9094352	bluebunch wheatgrass	6/2/2010	9.5	0.5

Site preparation: All three fields were prepared using an S-tine field cultivator and packed with a Brillion packer prior to seeding. The prior crop was an oats cover crop that was chemically killed with glyphosate herbicide the summer of 2009. No pre-plant herbicides were used. Field conditions were good with a firm seedbed. Soil moisture was good.

Seeding: A modified Truax grass drill was used for the planting. The seed was planted in 42 inch rows. Seed was planted approximately ½ inch deep.

Mountain brome: accession 9094354

A one-acre field of mountain brome was planted in field E-10 at the PMC on May 26, 2010. The field was seeded at a rate of 10 lb pure live seed (PLS)/ac, resulting in 25 PLS per foot of row to be planted.

Field Maintenance:

2010: The field was irrigated for 3 hours on June 9. The field was sprayed for weeds using Buctril™ herbicide at a rate of 1.5 pints per acre on June 17. The field was mowed for weed control on July 22 with a rotary mower. A fall pre-emergent application of Trust™ herbicide was applied on September 21 at a rate of 4 pints per acre. No fertilizer was applied during the establishment year.

2011: Residue was burned April 13. Forty pounds of actual nitrogen fertilizer was applied on April 28. Curtail Herbicide was applied on May 18 at a rate of 2 pints per acre. Class Act surfactant was tank mixed with the herbicide. The field was tilled between rows on September 6. The field was fall fertilized with 40 pounds of actual nitrogen as granular 46-0-0. The field was sprayed with Trust herbicide for pre-emergent control of spring weeds on November 4.

2012: The field was rototilled between rows on April 26. Prowl herbicide was applied pre-emergent at a rate of 2 quarts per acre on April 26. Tillage between rows was done after harvest on July 17. The field was irrigated on August 30 applying approximately 1 inch of water. . Forty pounds per acre of actual nitrogen was applied as dry urea 46-0-0 on September 17. The field was irrigated with ½ inch of water on September 20 to help incorporate the fertilizer. On October 2 the field was sprayed with Trust herbicide at a rate of 4 quarts per acre for pre-emergent spring weed control.

Harvest and Cleaning:

2010: The mountain brome grass field established quickly and resulted in excellent stand by the end of the growing season. The field was not harvested in 2010.

2011: Smut infected the entire field. The field was straight combined on July 26 producing 19.22 PLS pounds of seed. The seed was cleaned using a 3-screen fanning mill using a no. 12 screen for the first screen a 1/16 x 1/2 inch screen for the second screen and a 9 tri screen with 1 inch opening for the third screen. The air speed was set at 243 rpm with the side plate open.

2012: The field had very little smut infection compared to 2011. This was attributed to the drier less humid growing conditions. The field had good seed production and was straight combined on July 2 using a Kincaid model 17 combine. Dirty seed harvest was 1,056 dirty pounds. The seed was cleaned using a Clipper 3 screen fanning mill with settings the same as in 2011. Clean seed was 908 pounds resulting in 792 pounds of PLS after testing.

Slender wheatgrass: accession 9094353

A one-acre field of slender wheatgrass was seeded in field E-11 on May 26, 2010. The seeding rate was 5.5 lb PLS/ac for 20 PLS seeds per foot of row.

Field Maintenance:

2010: The field was irrigated for 3 hours on June 9. The field was sprayed for weeds using Buctril™ herbicide at a rate of 1.5 pints per acre on June 24. A second application of Buctril™ herbicide was applied on July 16th using a rate of 1.5 pints per acre. The field was mowed for weed control on July 21 with a rotary mower. A fall pre-emergent application of Trust™ herbicide was applied on September 21 at a rate of 4 pints per acre. No fertilizer was applied during the establishment year.

2011: The field was burned on April 13 to remove excessive residue. Fertilizer was applied on April 28 at a rate of 40 pounds of actual nitrogen. On May 19 Curtail herbicide was applied for broadleaf weed control at a rate of 2 pints per acre. Class Act surfactant was tank mixed with the herbicide. The field was rototilled between rows on September 7 after seed harvest. Forty pounds of actual nitrogen in the form of urea-46-0-0 was applied on October 18. The pre-emergent herbicide Trust was applied on November 4th at a rate of 4 pints per acre.

2012: The field was rototilled between rows on April 26. Prowl herbicide was applied at a rate of 2 quarts per acre on April 26. The field was mowed and tilled after seed harvest on July 24 and 25. On August 15 1/2 inch of irrigation water was applied to the field. September 17 the field was fertilized using 40 pounds actual N of 46-0-0 fertilizer. The fertilizer was incorporated with irrigation water the following day at a rate of 1/2 inch. Four pints per acre of Trust herbicide were applied to the field on October 1.

Harvest and Cleaning:

2010: The slender wheatgrass field established quickly and a good stand was established by the end of the growing season. The field was not harvested in 2010.

2011: Seed was straight combined using a Massey Ferguson model 17 (MF-17) combine on July 20. Combine settings were set for a cylinder speed of 1000 rpm, cylinder clearance 7mm, fan wind speed 2 rpm and the fan door adjustment was set on 4. The chaffer sieve adjustment was 1/2 inch open and a medium hole finishing sieve was used. The ground speed was 2 mph. Seed was cleaned using a 3 screen fanning mill. The first screen was a number 11, second was 1/12x1/2 inch and the third screen was a 9 tri with 1 inch open. The air speed was 234 rpm and the side plate was open. The seed amount was 570 PLS.

2012: The field was straight combined on July 3 using a MF-17 combine. The seed was cleaned using the same settings and screens as 2011. Clean seed was 825 PLS.

Bluebunch wheatgrass: accession 9094352

A 0.5-acre field of bluebunch wheatgrass was seeded in field E-10 on June 6, 2010. The seeding rate was 9.5 lb PLS/ac for 30 PLS seeds per foot of row.

Field Maintenance:

2010: The field was irrigated for 3 hours on June 9. The field was mowed for weed control on July 21 with a rotary mower. A fall pre-emergent application of Trust™ herbicide was applied on September 21 at a rate of 4 pints per acre. No fertilizer was applied during the establishment year.

2011: April 29 the field was fertilized with 40 pounds of actual urea nitrogen. Rows were tilled on May 9. The field was hand weeded on June 7 and 8. On June 27 the field was sprayed with a fungicide for smut control. This was not effective. On October 18 fertilizer was applied at a rate of 40 pounds per acre of actual nitrogen. The field was sprayed with Trust herbicide at a rate of 4 pints per acre.

2012: The stand is poor with numerous bare areas within the rows. Prowl herbicide was applied on April 26 using a rate of 2 quarts per acre. The field became weedy and was mowed on July 17 and again on August 6. Trust Herbicide was applied at a rate of 4 quarts per acre on October 2. The field has a poor stand and will be terminated in 2013.

Harvest and Cleaning:

2010: The bluebunch wheatgrass field was slow to establish. Seedling vigor was noticeably poor for the bluebunch wheatgrass, resulting in a fair stand by the end of the growing season. The field was not harvested in 2010.

2011: The field was harvested on July 22 a poor harvest resulted in less than ½ pound PLS.

2012: The field was not harvested.

No seed was distributed to the park in 2011 or 2012.

Accession Number	Species	Date Planted	Field Size (ac)	Seed Production (PLS lbs)			2011 Seed Harvest Date	2012 Seed Harvest Date	Total Seed Distributed to the Park (PLS lbs)	Total Seed Remaining on Inventory (PLS lbs)
				2010	2011	2012				
				9094352	bluebunch wheatgrass	6/2/2010					0.50	no harvest	0.27	0.00	7/22/2011	no harvest	0.00	0.27
9094353	slender wheatgrass	5/26/2010	1.00	no harvest	570.30	825.00	7/20/2011	7/3/2012	0.00	1395.30
9094354	mountain brome	5/26/2010	1.00	no harvest	19.20	792.00	7/26/2011	7/2/2012	0.00	811.20

ACTIVE STUDIES - TECHNICAL REPORT 2011-2012

Study No. NDPMC-T-0902-WL

Study Name: Big sage (*Artemisia tridentata* ssp.wyomingensis Beetle & Young) source development

Introduction: The study plan and the study supplement are found in Figure BS-1 and Figure BS-2. Following is the seed collection information for 2009.

Cooperators: USDA Natural Resources Conservation Service; USDI Bureau of Land Management; Bowman County Soil Conservation District; North Dakota Game and Fish Department; USDA Farm Services Agency; and landowners: Bernard and Carol Nelson Trust , and Erickson Living Revocable Trust

Figure BS-1. Study Plan – Big sage *Artemisia tridentata* ssp.wyomingensis

Study ID Code	NDPMC-T-0902-WL
Title	Big sage Source Development (<i>Artemisia tridentata</i> ssp wyomingensis Beetle & Young)
Study Type	Initial Evaluation
Location	NDPMC; CRP - Bowman County, North Dakota
Study Leader	Dave Dewald, Jeff Printz, Nancy Jensen
Duration	2009 - 2013
Cooperators	USDA, NRCS State Office, Plant Materials Center, Bowman FO USDI, BLM (Dickinson)
Land Use	Rangeland - Sage brush steppe
Related Practices	Rangeland - Sage brush steppe Secondary - Range seeding - CRP plantings
Resource Concerns	Plants - loss of Wyoming big sage loss cause depletion of primary food for sage grouse Animals - reduction of sage grouse populations due to lack of primary food
Long Range Plan	ND PMC Long Range Plan; Goal - Native Prairie Ecosystem Restoration
Description	A source of big sage seed and plants will be developed Seed and plants will be adapted to western North Dakota and South Dakota Plant materials will be used to replant disturbed sage grouse habitats
Technology Products	Publication depicting propagation/planting methods for Wyoming big sage

Figure BS-2. Study Plan Supplement – Big sage *Artemesia tridentata ssp.wyomingensis*

Study ID Code	NDPMC-T-0902-WL	
Title	Big sage Source Development	
Study Type	Initial Evaluation	
Location	Bismarck Plant Materials Center	
Study Leader	Dave Dewald, Jeff Printz, Nancy Jensen	
Duration	2009- 2013	
Cooperators	USDA, NRCS - State Office, PMC, Bowman Field Office; USDI, BLM (Dickinson, ND)	
2009-2013		
Materials and Methods	When	Responsibility
Seed Collection		
Locate site with big sage in Bowman County	Oct-Nov 2009	T. Zachmier, BLM
Hand strip North Dakota seed	Oct-Nov 2009	D. Dewald
Clean North Dakota seed	Dec 2009	N. Jensen
Order backup seed source from Wind River Seed Co., WY	Oct 2009	PMC - M. Knudson
Propagation		
Grow 1000 plants from ND source in greenhouse	Feb 2010	N. Jensen
Hold ND seedlings at PMC until 2011		N. Jensen
Secure 500 seedlings from BLM, Montana	Oct 2009	T. Zachmeier
Secure biodegradable seedling protection tubes		C. Stange
Field Planting		
Locate planting site for MT seedlings	Jan 2010	Bowman FO
Outline planting method and layout	Mar 2010	D. Dewald
Plant 500 MT seedlings - Bowman County CRP	May 2010	C. Zachmeier, Bowman FO
Locate planting site for ND seedlings	Mar 2011	Bowman FO
Plant 1000 ND seedlings	Apr 2011	C. Zachmeier, Bowman FO
Plant 1000 ND seedlings	Apr 2012	C. Zachmeier, Bowman FO
Field Evaluation		
Evaluate success of field plantings	Aug 2010	D. Dewald, N. Jensen, Bowman FO
Evaluate success of field plantings	Aug 2011	D. Dewald, N. Jensen, Bowman FO
Evaluate success of field plantings	Aug 2012	J. Printz, N. Jensen, Bowman FO
Evaluate success of field plantings (final)	May 10 11 2012	J.Foreman,C. Zachmeier, J. Fetting, W. Duckwitz, J. Honeyman, J. Printz
Seeding Trial		
Evaluate fall 2009 big sage CRP seedings	May 2010	Bowman FO, D. Dewald
Publish Results		
Publication depicting propagation/planting methods for Wyoming big sage	Jan 2013	N. Jensen, J. Printz
Publish Final Report	Nov-12	J. Printz

Seed Collection:

Site location: Big Gumbo (BLM land) near Marmarth, North Dakota; in Bowman County.

Legal Description: T130N R107 Sec 1 SWNE. UT Coordinates: 576,992-Easting; 5,106,688-Northing. The site was mostly gently sloping hillside and road ditch. Tim Zachmeier, Wildlife Biologist from the Dickinson BLM field office, located the site. Big sage plants were abundant. There was not a thick understory of grass. Seed heads were abundant on the plants.

Date: 11/10/09

Collectors: Dave Dewald, Jeff Printz, Cindy Zachmeier, and Nancy Jensen, USDA, NRCS North Dakota; and Tim Zachmeier, USDI, BLM North Dakota

Method: Seed was hand stripped. It was optimum dryness and ripeness for hand stripping rather than clipping the heads. Seed was put in paper bags to transport to the Plant Materials Center. Bags were opened to remove any moisture (moisture was minimal).

Accession: 9094331 was assigned to the Bowman County collection

Amount: 20.2 pounds of dirty seed; 1.4 pounds of clean bulk seed. Seed material was hand stripped. The seed was cleaned at the Plant Materials Center using a hammermill and office-size clipper fanning mill. The hammermill was used to separate the outer flower material from the tiny seed. Seed was run through the fanning mill several times with various small screens. The large inert material was scalped off first with clipper no. 8 and 9 round-hole screens and then seed was run over the smaller screens ranging from number 1/16 to 1/12 round-hole screens with little or no air separation.

Comments: Seed should be ripe and dry, but not shattering for optimal seed harvest. Cleaning stripped seed appears to be easier than clipped heads. The seed is small and clings to any plant debris. The seed has a very strong odor, even after cleaning. Seed will be propagated in the greenhouse at the PMC in 2010. Seedlings will be held over until planting in 2011.

Methods and Materials

Big sage, was planted in the field to determine the success of various propagation and planting techniques in reestablishing big sage within greater sage grouse, *Centrocercus urophasianus*, habitat. The Bernard and Carol Nelson Trust site is currently enrolled in CRP Sage Grouse SAFE, which required the establishment of big sage to qualify. This project will also teach practitioners the survival rates of sage grown by different methods, planted on different soils with various planting techniques. This was not a replicated study other than to find 17 locations of clayey, thin clay pan and clay pan soils within the property.

Five hundred, one year old plants were received from the Bureau of Land Management. These were grown from seed collected in and around Roundup, MT, and grown from seed in containers outdoors. These plants had stiffer (woody) larger diameter stems than the other sage source and average about 2-3" tall. They had been acclimated by growing outside, from seed, in containers last year, and healed in with straw over winter at Helena, MT. When removed from the straw cover, they were shipped to Bismarck, Plant Materials Center (PMC) and further hardened off by being placed outdoors of the green house.

One hundred plants collected from seed southwest of Marmarth, ND, were planted in early March in the Plant Materials Center Green house. They averaged about 4" tall, with slender, succulent stems. These plants had only been exposed to 1 day of outside air conditions before planting in the field (Risk of frost damage was too great prior to field planting.)

Sage plants were protected with 5" tall by 4" diameter cardboard tubes held in place with 2- 10" wire staples on all plots except the BLM source plants on plot 17. The tubes were cut from the disposable center tubes that come with weed control barrier. Side wall thickness of these cardboard tubes was 1/2", 3/8" and 1/4" depending upon source, which should affect longevity of the protective tube. Bottom of each tube was nested tight against the soil surface creating a water tight seal. These tubes were only pushed into the soil surface about a 1/2 inch, creating little obstruction to root expansion and development. The younger 84 sage plants received 2-5 cups of water after planting. (Glugged a bit of water out of a jug resulting in 1"-3" of water in the tube which soaked away within minutes.) A very few (< 15) of the 1-year old seedlings that were planted on a sandier spot, that was dry to touch, received 2-5 cups of water also.

Twenty plots were located with GPS and 30 spots per plot were treated with glyphosate on April 21, 2010 at a 3% rate. At planting time, April 28, 2010, 3 plots were not planted at all, to leave a few plants for planting on another property that had become available during the intervening week. One plot was relocated about 30 feet to the north and one was relocated about 200' to the southwest of the original plot

site. A few individual planting spots, within each plot, were moved a few feet to better soils. (After site prep, we learned that clay pan spots with clay pan at the surface, though mapped as a thin clay pan, were not suitable for sage planting. Additionally, the surface clay pans were so hard; a pick ax would have been needed to chop a 6" hole.) Individual planting spots that were relocated within each plot did not have the benefit of chemical burn-down, nor were they identified or located except as noted below. Plots 4 and 8 were moved entirely to an area with no burn down for reasons noted below.

All plots were numbered in the order they were planted. The first 4-5 plots on the Nelson property were planted in 65 degree weather with overcast skies and winds below 5 mph. The remaining plots were planted with 45 degree weather, 30-40 mph winds and intermittent driving rain. Just as the last plants were in the ground on the Nelson property, the winds calmed, temps rose to 50 degrees and the sun shone for the remaining 2 hours before sunset. On leaving Bowman the following morning we noticed frost on roof tops and a few grass spots all the way to Belfield. The cardboard tubes and the bit of early evening sunshine may have warmed the area enough that plants were not affected by frost. If the planting site received frost, we assume the 2-month old plants were severely damaged.

All plots on Nelson were 3 rows, primarily oriented southwest to northeast. Plot GPS point was usually, but not always, located in the middle of the northern most rows. After reducing the plant numbers available for this property the general scheme was to plant 25 plants per plot. Actual numbers varied based on location of suitable soils within plots or number of holes dug during the rain squall.

A small amount (handful to a cup) of soil was placed in or on some of the planting spots as indicated in the notes. This soil had been collected from beneath big sage plants on native rangeland. Research had hinted that introduction of mycorrhiza around each plant would increase plant survival and vigor.

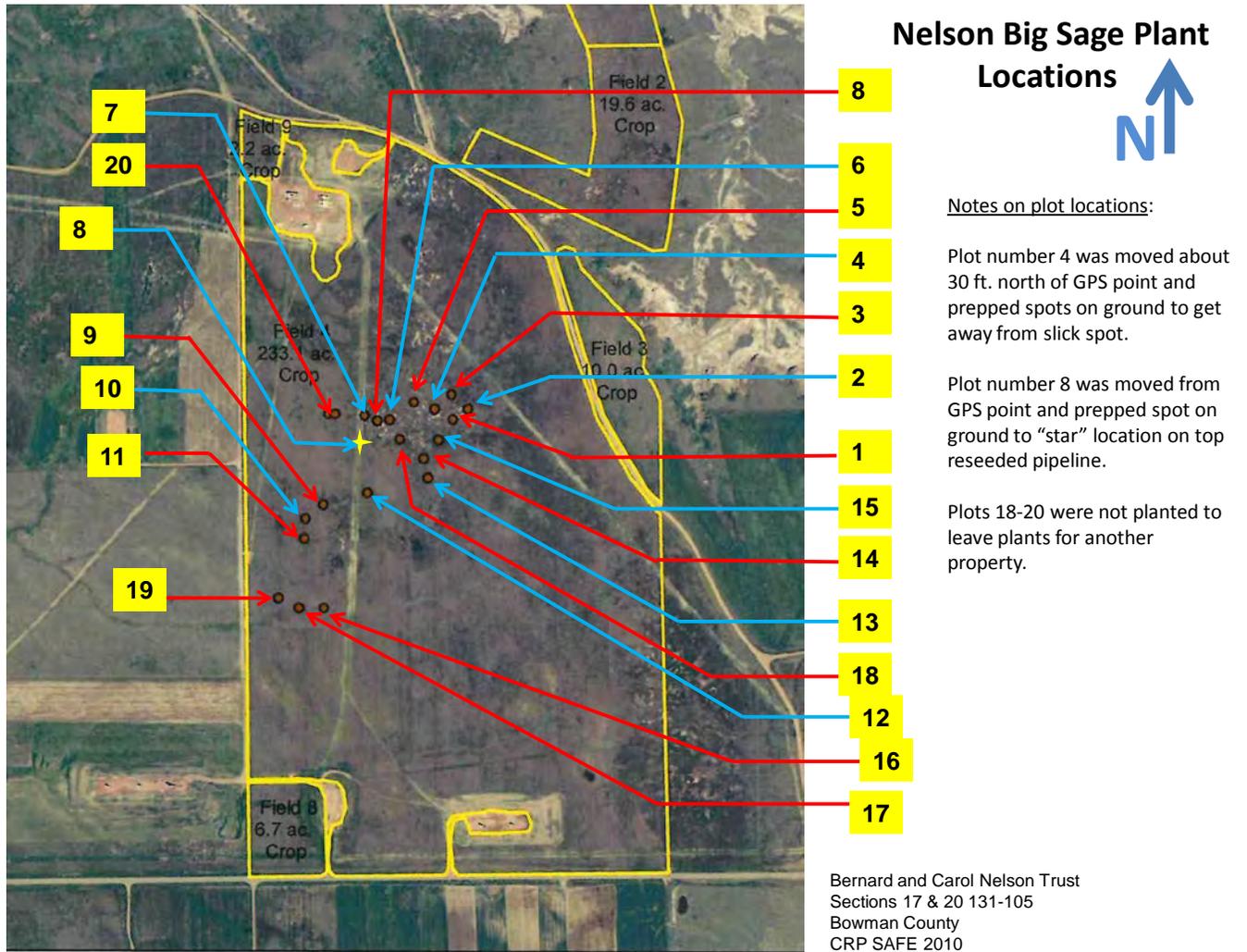
Once rains became more steady, and especially on sites where individual planting spots were located in sods, some of the sage seedlings were planted 2-3" deeper in the soil than the existing soil surface, since holes were dug deeper than the root ball and it was difficult to tear the rain wetted soil out of the root mass for filling the hole. On some locations, the tops of the cardboard tubes were only about 2-3" above the surrounding soil surface.

"Weather affected", as recorded below, means personnel were hurrying to get job done before field conditions became too slippery for vehicles to exit. Additionally, wind stress on seedlings was greater until tubes were installed. As mentioned above, soil was not as easy to replace around seedling roots.

On site personnel to help with the planting varied throughout the day with total representation of; 5 from North Dakota Game and Fish; one NDG&F volunteer (They were in the area conducting grouse counts already.); Two from the local NRCS office; 6 from NRCS state office and PMC; One from Bureau of Land Management.

Post plant note: NOAA weather forecast for May 4-5 call for; highs of 48, lows of 30, winds of 42-48 mph with gusts to 60 mph. The cardboard protective tubes may prove beneficial, if they do not blow away.

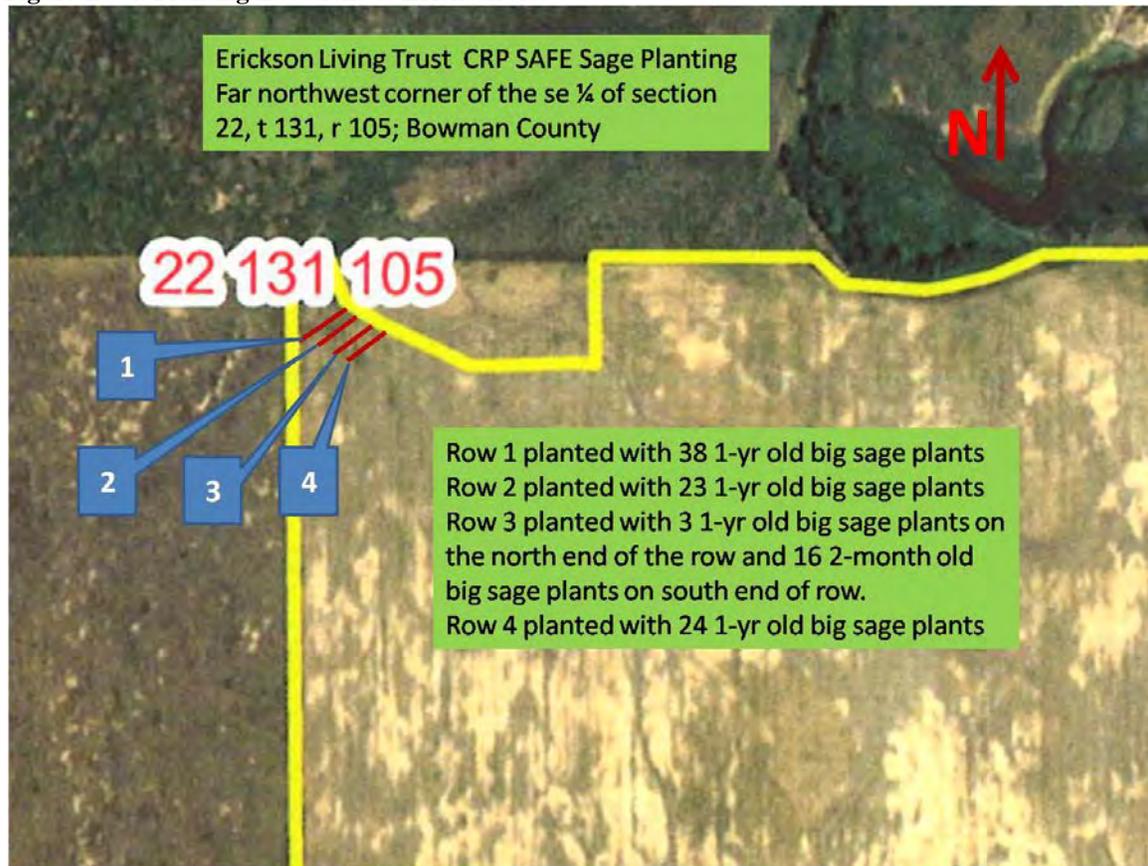
Figure BS-3. Planting Locations at Nelson site



Plot #	# 1-year old Seedlings Planted	# 2 month old Seedlings Planted	Individual Plot Notes
1	20	4	West 4 plants of row 2 are 2-month old seedlings. 1-year old seedlings were planted in row 1 just north of the plot GPS location to avoid a slick spot and in row 3. Mycorrhiza filled soil added to each plant. 5" protective tubes installed on each plant.
2	20	5	2- month-old seedlings were planted in north row with 3 plants west of GPS plot location and 2 plants to the east. Mycorrhiza filled soil added to each plant. 5" protective tubes installed on each plant.
3	20	5	The first 5 plants west of the GPS location are 2-month old seedlings, but a few were moved a few feet to avoid slick spots. 5" protective tubes installed on each plant. NO mycorrhiza filled soil was added to any plant.
4	20	5	This plot was moved about 30 feet north and west of GPS location to avoid large slick spot. New plot was flagged with flags in the northeast corner of plot, ie: far east end of north row. 2- month-old seedlings were planted in north row with all 5 plants immediately west of relocate plot flag. New plot location was not GPS located. No spots were burned back with glyphosate. Mycorrhiza filled soil added to each plant. 5" protective tubes installed on each plant. Rain, cold and wind affected planting conditions.

5	20	5	West end of original plot was not planted due to slick spot and was relocated to the south and west. 5 spots immediately west of the GPS plot location were planted to 2-month old seedlings. Relocated spots were not treated with glyphosate. Mycorrhiza filled soil added to each plant. 5" protective tubes installed on each plant. Rain, cold and wind affected planting conditions.
6	24	5	2-month old seedlings were planted in 5 western most spots of north row. One 1-year old plant was planted immediately west of GPS plot location. (6 total planting spots west of flag.) Mycorrhiza filled soil added to each plant. 5" protective tubes installed on each plant. Rain, cold and wind affected planting conditions.
7	20	5	2-month old seedlings were planted in 5 western most spots of north row. Mycorrhiza filled soil added to each plant. 5" protective tubes installed on each plant. Rain, cold and wind affected planting conditions.
8	19	5	Plot 8 was moved about 200 feet southwest of GPS plot location to the recently revegetated pipeline area to determine how well these plants might do in a young and densely stocked sweet clover cover on freshly disturbed soil. Rows were oriented north and south to fit entire plot on the pipeline area. 2-month old plants(5 total) were planted on south end of west row. Mycorrhiza filled soil added to each plant. 5" protective tubes installed on each plant. Rain, cold and wind affected planting conditions. Planting spots were not treated with glyphosate.
9	21	5	2-month old seedlings were planted in the 5 plots immediately west of GPS location. Mycorrhiza filled soil added to each plant. 5" protective tubes installed on each plant. Rain, cold and wind affected planting conditions.
10	20	5	2-month old seedlings were planted in the 5 plots immediately east of GPS location. NO mycorrhiza filled soil was added to any plant. 5" protective tubes installed on each plant. Rain, cold and wind affected planting conditions.
11	20	5	2-month old seedlings were planted in the 5 plots immediately east of GPS location. Mycorrhiza filled soil added to each plant. 5" protective tubes installed on each plant. Rain, cold and wind affected planting conditions.
12	19	5	2-month old seedlings were planted in the 5 plots immediately east of GPS location. Mycorrhiza filled soil added to each plant. 5" protective tubes installed on each plant. Rain, cold and wind affected planting conditions. Some plants were planted 2-3" below existing soil surface.
13	25	5	2-month old seedlings were planted in the 5 plots immediately east of GPS location. NO mycorrhiza filled soil was added to any plant. 5" protective tubes installed on each plant. Rain, cold and wind affected planting conditions. The good existing grass vigor would indicate some of the most productive soils are found on this plot.
14	25	5	2-month old seedlings were planted in the 5 plots immediately east and one immediately west of GPS location. Mycorrhiza filled soil added to each plant. 5" protective tubes installed on each plant. Rain, cold and wind affected planting conditions. Some plants were planted 2-3" below existing soil surface.
15	25	5	2-month old seedlings were planted with 4 plants immediately east of GPS location and 1 immediately to the west. NO mycorrhiza filled soil was added to any plant. 5" protective tubes installed on each plant. Rain, cold and wind affected planting conditions
16	26	5	2-month old seedlings were planted in the 5 plots immediately east of GPS location. Mycorrhiza filled soil added to each plant. 5" protective tubes installed on each plant. Rain and wind was starting to slacken.
17	25	5	2-month old seedlings were planted in the 5 plots immediately east of GPS location. NO Mycorrhiza filled soil was added to any plant. 5" protective tubes installed ONLY on the 5 2-month old plants. No more tubes remained. Rain and wind had pretty much quit by the time this plot was finished.
18	0	0	Not planted in order to leave planting stock for Erickson property
19	0	0	Not planted in order to leave planting stock for Erickson property
20	0	0	Not planted in order to leave planting stock for Erickson property
	369	84	Totals of sage plants planted on Nelson property. Total plants equal - 453

Figure BS-4. Planting Locations at Erickson site



The big sage plants on the Erickson property were planted without any site prep (burndown) in late afternoon (after planting big sage on the Nelson property) on April 28, 2010. The entire field had been drilled (dormant fall seeding 2009) to a mixture of native grass. Following grass seeding, Wyoming big sage seed was broadcast across the entire field prior to snowfall. In places across the entire CRP contract rows of young grass seedlings from last year's seeding could be observed. We did not note any young sage emerging from the sage seeded with the grass. We did observe a big sage plant about 8" high that was growing in that part of the field marked out as not part of the CRP contract. This area appears to have been uncropped for the previous several years, probably due to poor access as a result of the gully and sediment along the south side of that area.

The big sage seedlings were planted in the triangle left between the pasture fence and the gully and sediment area. Rows were oriented northeast to southwest. Elevation change across the rows was approximately 4'. Row were a nominal 8' apart, but varied a few feet throughout. Plant spacing within the row was 4-8'. Planting conditions were ideal. Field conditions were moist soil, little wind, cool temps, and late afternoon sun. Details for each row planted are listed below. None of these rows were located with GPS. Rows were marked with flags on the ground and with flags wrapped in the fence wire on each edge of the planting.

This should be a good test of unprotected sage plants on recently disturbed soils with little aggressive sod competition. However, all plants will experience dense kochia competition.

Table BS-2. Planting Numbers and Notes on Erickson Big Sage Planting Site			
Plot #	# 1-year old Seedlings Planted	# 2 month old Seedlings Planted	Individual Plot Notes
1	38	0	Planted into a solid stand of young kochia. Kochia plants were sprouted at 2-10/ square inch. Soil was moist and at field capacity. Texture was loam to clay loam. Northeast end of row (2-5 plants) was planted, in sediment deposits from gully which were coarser textured with fewer emerged kochia due to recent sedimentation. No tubes were added, no mycorrhiza added, no water added. Planted row stopped about 20' south of east west fence.
2	23	0	Planted into a solid stand of young kochia. Kochia plants were sprouted at 2-10/ square inch. Soil was moist and at field capacity. Texture was loam to clay loam. Northeast end of row (2-5 plants) was planted, in sediment deposits from gully which were coarser textured with fewer emerged kochia due to recent sedimentation. No tubes were added, no mycorrhiza added, no water added. Planted row stopped about 30' south of east west fence.
3	3	16	Planted into a solid stand of young kochia. Kochia plants were sprouted at 2-10/ square inch. Soil was moist and at field capacity. Texture was loam to clay loam. Northeast end of row (2-5 plants) was planted, in sediment deposits from gully which were coarser textured with fewer emerged kochia due to recent sedimentation. No tubes were added, no mycorrhiza added. About 2-3 cups of water were added to the 2 month old plants. Planted row stopped about 30' south of east west fence.
4	24	0	Planted into a solid stand of young kochia. Kochia plants were sprouted at 2-10/ square inch. Soil was moist and at field capacity. Texture was loam to clay loam. No tubes were added, no mycorrhiza added, no water added. Planted row stopped about 50' south of east west fence.
	88	16	Total Big Sage planted = 104

Figure BS-5. Final Big Sage report, November 2012

November 5, 2012

Background:

On May 10 and 11, 2012, Jody Forman, Cindy Zachmeier, Jon Fettig, Wayne Duckwitz, Jaden Honeyman, and Jeff Printz conducted a review of the big sagebrush plantings completed from 2009 to 2011 in western Bowman County. The purpose of this review was to evaluate effectiveness of different planting techniques, site selection, and timing.

Findings and Recommendations:

1. Plantings made during early spring or late fall periods appear to have the best survival rates, while plantings made during the late summer period had the worst survival rates.
 - a. **Recommendation:** Limit planting windows to early spring and late fall, provided soil moisture conditions are favorable.
2. Age of vegetative material didn't seem to affect survival rates. Survival rates for stock transplanted to field sites the same year as germination appeared to have the same survival rates as two year old stock.
 - a. **Recommendation:** Propagate material in the greenhouse in January/February to be planted in early spring or held over the summer for planting in late fall. It can be difficult to maintain containerized material over the summer, but small quantities are manageable.
3. Pre-treatment of planting areas (spot spraying with Glyphosate) did not appear to improve survival.
 - a. **Recommendation:** Based upon this review, it does not appear necessary to eliminate the grass competition by spot spraying with Glyphosate.
4. The use of cardboard shelters did not improve survival rates.
 - a. **Recommendation:** Based upon this review, it does not appear that the cardboard tubes provide any benefit to the big sagebrush seedling.
5. Planting sites with clayey soils proved problematic. It was difficult to properly replace soil around roots on sites with heavy clay soils. This resulted in lower survival rates due to air spaces and poor soil to root contact. Loam and sandy loam surface textures provided the best potential for survival.
 - a. **Recommendation:** Select planting sites with loam, sandy loam, or sandy surface textures to ensure good soil to root contact and reduce the potential of air pockets near roots.
6. Some plantings were done using a sharpshooter to dig holes (left photo below) while others were done with a Giddings probe truck with an auger attachment (middle photo below). Using the Giddings auger was much faster and easier, although this method still required some shovel work to clean out the holes before planting (right photo below). Proper compaction around the plants was an issue with either method when planting in clayey soils.

November 5, 2012



- a. **Recommendation:** When possible, utilize a Giddings probe truck with auger attachment for drilling the holes during planting. Although this still requires some shovel work, labor and planting time is greatly reduced.
7. Initial planting sites within each field were selected by correlating soils/landscapes to ecological site descriptions which indicated big sagebrush would have been present in the reference plant community. Since big sagebrush is not fire tolerant, it most often would have occurred on those ecological sites which, in reference condition, did not produce adequate fine fuels to carry a fire with any regular frequency (i.e. thin claypan, dense clay, shallow clay). However, due to the difficulties in obtaining good soil to root contact when planting, ecological sites with clayey surface textures may not provide the best alternatives when selecting planting sites. Since fire (wildfire and prescribed burning) is presently a very seldom occurrence, selecting sites where big sagebrush was not a reference plant community component is an alternative. Based upon the results of this review, big sagebrush is adapted to other sites, especially when established using containerized plants.
- a. **Recommendation:** Although adapted to other ecological sites, selecting planting sites based upon ecological sites which afford a more open plant community (e.g. less foliar cover, more bare ground) would offer opportunities for further propagation by seed once the plants are established.

November 5, 2012

➤ **Site 1**



- Planted spring of 2011
- 50-60% survival
- Good soils
- Surviving plants showed good vigor
- Smooth brome was dominant vegetation

➤ **Site 2**



- Planted spring of 2011
- East plantings were better
 - More cover
 - More vegetation-crested wheatgrass dominant
 - More vigorous
- West plantings
 - Less vigorous
 - 45% survival
 - Sandy soils

November 5, 2012

➤ **Site 3**



- Planted using Giddings auger truck in October, 2011
- Very heavy compacted soils at planting site
- 90% survival on plantings with Giddings auger truck
- 50% survival on hand plants
- Clayey soils
- Bare soil surface with no cover
- Below average seedling vigor

➤ **Site 4**



- September 2011 planting
 - No success
 - Grasshoppers were noted on the new plugs shortly after planting
 - Hot temperatures
 - Dry soils
 - Plugs were watered after planting
 - Planted into native grass
- October 2011 planting
 - 90% success
 - Variation in soils
 - No difference between native planting and crested wheatgrass/alfalfa
 - No difference between those planted using the Giddings auger truck and hand planted

November 5, 2012

➤ **Site 5**



- Planted October, 2011
- Planted using Giddings auger truck
- 90% survival
- Native grass seeding on pipeline
- Sandy loam soils

➤ **Site 6**



- Planted May, 2011
- 4 plantings going from east to west
 - 20,30,60,80% survival respectively
- Survival was much better on lighter soils
- The site had been hayed in 2011, so true potential was hard to judge
- Crested wheatgrass/alfalfa dominant cover

November 5, 2012

➤ **Site 7**



- September, 2011 planting
 - Early September planting
 - Hand planted using shovels
 - Smooth brome dominant cover
 - 8,15,20% survival respectively across site
 - Very dry conditions
 - Poor planting conditions
- October, 2011 planting
 - Planted using Giddings auger probe truck
 - Sandy soils
 - Smooth brome dominant cover
 - 90% survival
 - Vigorous
 - Existing silver and big sage had a lot of decadence due to girdling by rodents

➤ **Site 8**



November 5, 2012

- Big sagebrush seed was broadcast by hand out of the back of a pickup onto snow cover in November of 2009 after grass mixture was seeded fall dormant.
 - Broadcast seeding was considered successful for those small areas of the field on which the seed was broadcast; however, actual seeding rate is not known - nor is it known how many areas within the field received seed but failed to grow
- Hand planting completed April of 2010
 - 50% survival on hand plants
 - Heavy cardboard used as a shelter for the plugs
 - Good moisture at time of hand planting
 - Northeast corner of planting was too wet and some of the plants may have drowned out

➤ **Site 9**



- Planted April of 2010
- Planting sites were spot sprayed with Glyphosate.
- Good survival across most sites
- Thin claypan sites were difficult to plant due to clay surface texture and limited depth of topsoil over claypan (0 to 4 inches)

ACTIVE STUDIES: TECHNICAL REPORT 2011-2012

Study NDPMC-T-0105-CP

Study Title: Plant Materials for Saline Sites

Introduction: Salinity is a soil property referring to the amount of soluble salt in the soil. It is generally a problem of arid and semiarid regions. Electrical conductivity (EC) is the most common measure of soil salinity and is indicative of the ability of an aqueous solution to carry an electric current.

By agricultural standards, soils with an EC greater than 4 dS/m are considered saline. In actuality, salt-sensitive plants may be affected by conductivities less than 4 dS/m and salt tolerant species may not be impacted by concentrations of up to twice this maximum agricultural tolerance limit.

Objective: Compare establishment and forage production of perennial grasses and legumes over salinity gradients.

Cooperators: Carrington Research Extension Center, Carrington, North Dakota The USDA Natural Resources Conservation Service Plant Materials Center, Bismarck North Dakota, Foster and Stutsman County Soil Conservation Districts

Location: Three sites located near Barlow, Buchanan, and Carrington, North Dakota

Major Land Resource Area: The study is located in MLRA 53B.

Soils:

Barlow: G211A, Fram-Wyard loams, 0 to 3 percent slopes
G229A, Heimdal-Emrick loams, 0 to 3 percent slopes

Buchanan: 18, Hamerly-Svea loams, 0 to 3 percent slopes
24, Svea-Barnes loams, 0 to 3 percent slopes

Carrington: G119A, Vallers-Hamerly loams, saline, 0 to 3 percent slopes
G230B, Heimdal-Esmond loams, 3 to 6 percent slopes

Materials and Methods

Planting Plan: Three off center demonstration plots were seeded the spring of 2010. Two of the plots are located in close proximity of the Carrington Research and Extension Center located in central North Dakota. The third is located east of Buchanan, North Dakota. The plots will not be replicated but each species will be planted through a recorded salinity gradient. Data collection will be as follows:

1. Plant germination and stand establishment counts were taken across the gradient for each species.
2. Stand health and progression or regression across the gradient will be measured annually.
3. EC will be measured at intervals across the gradient with an EM 38 machine at planting and annually to map changes in salinity throughout the plots over time.
4. Plant herbage production will be taken across the gradient for each species to determine potential yield of each species at differing salinities on dates deemed most appropriate for optimum forage harvest. Grasses will be clipped once per season. Alfalfa and legume species will be clipped twice per year if regrowth is sufficient after the first cutting.
5. Forage quality will be analyzed on all grass species in the trial.

Species List:

Smooth Bromegrass - Rebound
Tall Wheatgrass – Alkar
Hybrid Wheatgrass - NewHy
Manystem Wildrye – Shoshone
Creeping Foxtail – Garrison

Green Wheatgrass - AC Saltlander
 Slender Wheatgrass – Revenue
 Western Wheatgrass - Rodan
 Canada Wildrye - Mandan
 Switchgrass – Forestburg
 Prairie Cordgrass - Red River
 Prairie Cordgrass - CREC Germplasm
 AC Saltlander Commercial Mix
 Alfalfa – 12 varieties/lines
 Strawberry Clover - O'Connors
 Forage Kochia - 2 sources

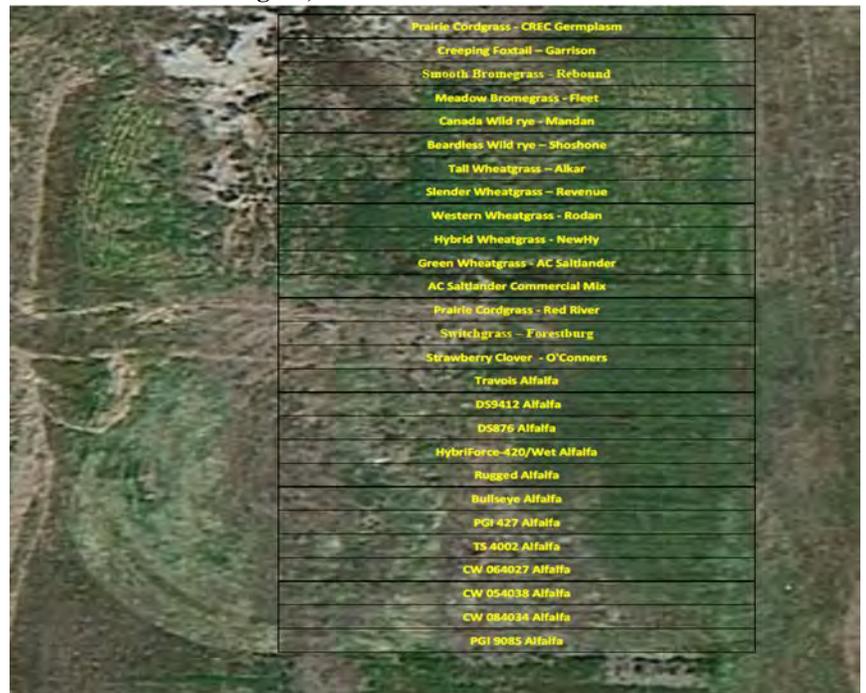
Site Preparation: The sites were tilled prior to seeding

Planting Method: Each plot is 10 feet wide by 200 feet long. A plot drill was used to seed all the plots.

Planting Date: Carrington and Barlow, May 22, 2010 and Buchanan, June 10, 2010

Irrigation: The fields are not irrigated.

Figure CA-1. Plot layout of salinity demonstration at the Pasta Plant location near Carrington, North Dakota



Results and Discussion

A considerable amount of information contained in this report has been provided by Ezra Aberle, Agronomy Research Specialist with the Carrington Research Extension Center.

2010: Plant germination and stand establishment counts were taken across the gradient for each species. Seedlings emerged in most of the test areas however many succumbed to the harsh environment in the more saline areas. This season the wheatgrasses provided thicker and more consistent stands across the gradient from non-saline to saline soil than the other grasses tested. This may change over time. There does not appear to be any clear differences in establishment of the alfalfas tested. This demonstration will track salinity, stand, and forage production over several seasons to help determine the most appropriate species for various salinity levels and targeted end uses by personnel, landowners, and/or renters. See **Tables CA-1, CA-2, CA-3** for 2010 stand evaluation data.

2011: Plots received above normal precipitation this year, with some areas subjected to short term flooding. Plots with adequate stands were harvested at the approximate stage for hay production for each species. The prairie cordgrass plots were not harvested due to minimal, inconsistent, stands throughout the gradients. However, they may be harvested in the future if the stand improves. Harvested forage was weighed to determine yield and sampled for forage quality analysis. EC readings were taken in plots the same day they were harvested for yield. The Barlow site was clipped this year, but abandoned in the fall due to excessively saturated soils and loss of stand as a result. Forage production across increasing salinity levels at the Pasta Plant, Buchanan, and Barlow locations is shown in **Tables CA-4, CA-5, and CA-6** respectively. Tall wheatgrass, Canada wildrye, Shoshone many-stem wildrye, most wheatgrasses, and salt tolerant crosses and mixes performed well, even in EC readings as high as 8. Tall wheatgrass, Shoshone many-stem wildrye, NewHy and the forage mix appeared to tolerate the highest saline conditions. Alfalfa production dropped off considerably in most entries, as EC ratings approached 5. **Tables CA-7, CA-8, and CA-9** provide forage quality data of the grasses across different salinity levels at the Pasta Plant, Buchanan, and Barlow locations respectively. The forage mix, wheatgrass crosses and western wheatgrass appeared to display the highest combination of protein and relative feed value in the grasses, and tall wheatgrass appeared to consistently be on the lower end of the quality scale.

2012: Plots received considerably less precipitation this growing season and salinity levels are generally reading lower as well. The Pasta Plant and Buchanan individual plots with adequate stands sites were again clipped at the approximate stage for hay production for each species. The wheatgrasses and manystem wildrye continue to provide stable yields across the salinity gradient. The wheatgrasses tested (with the exception of tall), the bromegrasses, and the wildryes provided forage with the quality to maintain a dry or early gestation beef cow. Salinity levels have dropped possibly as a result of the drier conditions this year. **Tables CA-10, CA-11, and CA-12** show total production from the grass and alfalfa plots with different salinity gradients at the Pasta Plant and Buchanan locations, respectively. **Tables CA-13 and CA-14** provide forage quality data from the Pasta Plant and Buchanan sites, respectively.

Listed below are definitions of abbreviations used in the following tables:

EC = ELECTRICAL CONDUCTIVITY,%	TDN = TOTAL DIGESTIBLE NUTRIENTS EST.,%
CP = CRUDE PROTEIN,%	DM = DRY MATTER,%
HDP = HEAT DAM. PROTEIN,%	DDM = DIGESTIBLE DRY MATTER,%
AP = AVAILABLE PROTEIN,%	Ca = CALCIUM (Ca),%
NFC = NON-FIBER CARB.,%	P = PHOSPHORUS (P),%
ADF = ACID DET. FIBER,%	K = POTASSIUM (K),%
NDF = NEUT. DET. FIBER,%	Mg = MAGNESIUM (Mg),%
CF = CRUDE FIBER,%	RFV = RELATIVE FEED VALUE

Table CA-1. 2010 Stand Counts (plants/ft²) at Pasta Plant Site

Trt #	Species	Type	Variety	Plot Width	Count 1	EC 1 @2"	Count 2	EC 2 @2"	Count 3	EC 3 @2"	Count 4	EC 4 @2"	Count 5	EC 5 @2"
1	Prairie Cordgrass		CREC Germplasm	5'	1	2.55	0	4.98	0	4.98	0	4.62	1	3.42
2	Foxtail	Creeping	Garrison	10'	23	2.73	9	4.96	0	4.96	0	5.57	4	2.27
3	Bromegrass	Smooth	Lincoln	10'	12	3.21	1	3.55	3	3.55	17	2.98	5	3.22
4	Bromegrass	Meadow	Fleet	10'	24	1.90	8	4.11	5	4.11	0	3.49	28	3.12
5	Wildrye	Canada	Mandan	10'	11	2.60	1	3.33	0	3.33	4	4.14	15	3.06
6	Wildrye	Manystem	Shoshone	10'	43	2.65	23	7.43	0	7.43	3	2.49	7	3.61
7	Wheatgrass	Tall	Alkar	10'	26	2.47	20	5.98	15	5.98	23	1.75	27	3.44
8	Wheatgrass	Slender	Revenue	10'	29	1.35	19	5.18	0	5.18	18	3.85	6	4.37
9	Wheatgrass	Western	Rodan	10'	11	1.22	15	2.80	6	2.80	3	4.60	9	3.56
10	Wheatgrass	Hybrid	NewHy	10'	29	1.21	28	4.29	4	4.29	0	3.61	13	3.36
11	Wheatgrass	Green	AC Saltlander	10'	34	1.38	11	4.52	0	4.52	4	5.45	11	3.61
12	Saltlander Forage Grass Mix			10'	42	1.62	12	3.92	7	3.92	30	2.80	26	3.82
13	Prairie Cordgrass		Red River	5'	0	1.12	1	3.46	0	3.46	0	4.14	0	2.55
14	Switchgrass		Forestburg	10'	68	1.15	17	3.22	1	3.22	0	4.30	1	3.07
15	Clover	Strawberry	O'Conners	10'	16	1.11	9	3.18	12	3.18	0	3.47	5	1.75
16	Alfalfa		Travois	10'	43	1.82	25	2.46	4	2.46	18	4.37	34	3.38
17	Alfalfa		DS9412	10'	47	1.07	27	3.01	9	3.01	10	3.28	0	6.22
18	Alfalfa		DS876	10'	15	0.90	14	2.27	6	2.27	12	2.77	4	5.24
19	Alfalfa		HybriForce-420/Wet	10'	87	1.42	28	1.68	11	1.68	18	2.98	0	5.86
20	Alfalfa		Rugged	10'	30	0.89	28	2.29	6	2.29	37	2.93	6	3.72
21	Alfalfa		Bullseye	10'	58	1.37	33	1.91	25	1.91	9	2.93	0	4.50
22	Alfalfa		PGI 427	10'	69	0.40	35	2.55	12	2.55	15	2.75	1	4.70
23	Alfalfa		TS 4002	10'	43	.	32	2.70	18	2.70	8	2.27	2	3.71
24	Alfalfa		CW 064027	10'	49	0.51	39	2.19	6	2.19	17	3.23	3	3.46
25	Alfalfa		CW 054038	10'	40	0.46	16	2.46	9	2.46	16	2.57	3	4.71
26	Alfalfa		CW 084034	10'	17	0.40	29	1.74	38	1.74	18	2.37	11	2.47
27	Alfalfa	annual	PGI 908S	10'	33	0.47	17	2.49	10	2.49	9	3.63	4	3.95
28	Kochia1	Forage	Kochia	10'	1	.	0	3.11	0	3.11	0	2.87	0	.
29	Kochia2	Forage	Kochia	10'	7	.	3	.	1	.	1	.	2	.

Table CA-2. 2010 Stand Counts (plants/ft²) at Buchanan Site

Trt #	Species	Type	Variety	Width	Count 1	EC 1 @2"	Count 2	EC 2 @2"	Count 3	EC 3 @2"	Count 4	EC 4 @2"	Count 5	EC 5 @2"
1	Prairie Cordgrass		Red River	5'	0	1.36	1	2.24	0	2.54	0	3.48	0	2.40
2	Foxtail	Creeping	Garrison	10'	43	1.15	14	1.67	12	1.99	3	2.33	3	2.60
3	Bromegrass	Smooth	Lincoln	10'	44	1.36	25	1.58	17	1.68	8	2.34	1	2.60
4	Bromegrass	Meadow	Fleet	10'	30	1.29	26	1.52	18	1.40	10	2.34	2	2.47
5	Wildrye	Canada	Mandan	10'	22	1.53	11	1.43	15	1.63	6	1.86	2	2.49
6	Wildrye	Manystem	Shoshone	5'	38	1.32	17	1.09	14	1.46	5	2.19	2	2.48
7	Wheatgrass	Tall	Alkar	10'	26	0.99	28	1.42	23	1.50	18	3.41	16	2.97
8	Wheatgrass	Slender	Revenue	10'	48	1.70	23	1.32	16	1.58	11	2.53	4	3.89
9	Wheatgrass	Western	Rodan	10'	24	0.79	15	1.45	28	1.42	31	2.47	2	4.13
10	Wheatgrass	Hybrid	NewHy	10'	56	0.64	33	1.47	22	1.75	9	3.13	3	4.27
11	Wheatgrass	Green	AC Saltlander	10'	32	0.96	27	1.23	18	1.53	11	.	2	3.31
12	Saltlander Forage Grass Mix			10'	56	0.82	50	1.74	30	2.70	16	2.95	4	3.98
13	Switchgrass		Forestburg	10'	27	1.15	6	2.43	20	1.83	14	2.57	1	2.65
14	Clover	Strawberry	O'Connors	10'	56	0.81	26	0.98	18	2.22	10	1.88	1	3.16
15	Alfalfa		Travois	10'	23	1.01	21	1.74	14	2.53	8	3.01	4	3.04
16	Alfalfa		DS9412	10'	61	1.49	27	1.81	19	2.40	6	1.96	3	2.47
17	Alfalfa		DS876	10'	54	1.32	16	1.51	18	2.25	7	2.50	6	2.84
18	Alfalfa		HybriForce-420/Wet	10'	31	1.01	22	1.63	18	1.51	13	1.85	1	3.00
19	Alfalfa		Rugged	10'	61	1.55	21	1.74	12	1.82	22	1.75	2	1.91
20	Alfalfa		Bullseye	10'	36	0.72	27	1.25	23	1.67	9	1.87	1	2.36
21	Alfalfa		PGI 427	10'	26	0.75	22	1.53	20	2.35	3	2.00	3	2.98
22	Alfalfa		TS 4002	10'	42	0.90	24	1.56	21	1.76	13	2.25	1	2.33
23	Alfalfa		CW 064027	10'	30	1.06	22	1.59	12	2.99	8	1.57	1	3.55
24	Alfalfa		CW 054038	10'	39	0.91	20	1.65	11	2.63	7	3.59	2	5.05
25	Alfalfa		CW 084034	10'	28	1.25	23	1.77	17	1.54	9	2.23	1	4.87
26	Alfalfa	annual	PGI 908S	10'	19	1.46	17	1.44	9	1.70	3	1.80	2	1.76
27	Kochia1	Forage	Kochia	10'	0	1.41	0	1.77	0	2.33	0	2.31	0	3.89
28	Kochia2	Forage	Kochia	10'	15	1.40	3	1.56	1	1.61	0	1.71	0	2.33

Table CA-3. 2010 Stand Counts (plants/ft²) at Barlow Site

Trt #	Species	Type	Variety	Width	Count 1	EC 1 @2"	Count 2	EC 2 @2"	Count 3	EC 3 @2"	Count 4	EC 4 @2"	Count 5	EC 5 @2"
1	Foxtail	Creeping	Garrison	10'	13	1.40	6	3.24	1	1.38	30	1.13	0	2.50
2	Bromegrass	Smooth	Lincoln	10'	37	0.96	15	2.58	23	0.93	6	1.19	0	2.48
3	Bromegrass	Meadow	Fleet	10'	36	1.11	15	1.66	44	1.81	0	1.95	12	3.67
4	Wildrye	Canada	Mandan	10'	7	1.03	12	1.49	25	1.52	0	1.74	4	2.39
5	Wildrye	Manystem	Shoshone	10'	8	1.13	24	1.78	17	1.25	15	1.89	3	2.40
6	Wheatgrass	Tall	Alkar	10'	33	1.62	5	1.44	16	0.71	2	1.80	4	1.88
7	Wheatgrass	Slender	Revenue	10'	14	1.12	26	1.26	12	0.74	6	2.30	4	3.05
8	Wheatgrass	Western	Rodan	10'	13	1.19	16	0.71	4	0.91	10	2.32	3	1.90
9	Wheatgrass	Hybrid	NewHy	10'	18	1.27	27	1.30	16	0.83	2	1.65	6	2.50
10	Wheatgrass	Green	AC Saltlander	10'	12	1.03	31	0.88	29	1.16	2	0.68	7	2.83
11	Saltlander Forage Grass Mix			10'	52	0.56	16	0.81	6	0.56	12	1.71	32	3.42
12	Switchgrass		Forestburg	10'	29	0.86	13	0.86	9	0.82	10	2.19	1	2.69
13	Clover	Strawberry	O'Connors	10'	4	0.86	15	0.69	1	1.00	1	2.57	1	2.42
14	Alfalfa		Travois	10'	20	1.05	16	1.23	4	1.27	1	1.83	2	2.77
15	Alfalfa		DS9412	10'	16	0.74	5	1.17	30	0.86	0	1.97	3	3.31
16	Alfalfa		DS876	10'	20	1.08	19	1.35	12	1.42	0	2.82	2	1.84
17	Alfalfa		HybriForce-420/Wet	10'	10	1.36	18	1.51	0	1.87	2	2.67	1	3.35
18	Alfalfa		Rugged	10'	36	1.34	13	1.76	7	3.00	0	2.49	3	3.56
19	Alfalfa		Bullseye	10'	30	1.49	18	1.17	7	1.52	2	1.61	0	3.36
20	Alfalfa		PGI 427	10'	9	1.78	44	1.23	10	2.46	0	3.18	4	3.53
21	Alfalfa		TS 4002	10'	18	1.26	37	1.31	17	1.83	10	3.05	2	3.62
22	Alfalfa		CW 064027	10'	33	1.22	1	3.17	14	2.87	4	1.68	2	3.24
23	Alfalfa		CW 054038	10'	34	1.10	5	2.37	13	2.47	23	1.92	0	2.66
24	Alfalfa		CW 084034	10'	20	1.54	9	2.91	2	2.29	4	2.72	0	5.46

Table CA-4. Pasta Plant Site Production Data - 2011

Grasses						Alfalfa & Clover				
Variety	Species	Plot	EC	DM	Yield Dry T/acre	Variety	Plot	EC	DM	Yield Dry T/acre
Garrison	Creeping Foxtail	1	4.4	48%	3.1	Travois	1	2.0	31%	2.8
		2	4.6	37%	2.5		2	2.4	33%	3.6
		3	4.9	37%	2.3		3	2.4	33%	2.8
		4	6.2	37%	1.9		4	5.2	37%	2.7
		5	5.9	40%	1.4		5	5.7	33%	1.7
Averages-->			5.2	40%	2.2	Averages-->		3.5	33%	2.7
Lincoln	Smooth Bromegrass	1	3.8	34%	1.8	DS9412	1	1.3	31%	3.0
		2	4.4	55%	5.0		2	2.6	31%	3.5
		3	4.1	47%	3.0		3	3.4	32%	2.8
		4	5.5	50%	1.4		4	4.6	38%	1.4
		5	5.2	55%	2.1		5	6.6	25%	0.9
Averages-->			4.6	48%	2.6	Averages-->		3.7	32%	2.3
Fleet	Meadow Bromegrass	1	2.7	45%	1.9	DS876	1	1.4	31%	3.8
		2	3.3	48%	2.3		2	2.7	33%	3.0
		3	3.0	37%	2.1		3	3.7	32%	3.3
		4	4.7	51%	2.9		4	4.8	33%	1.9
		5	4.7	56%	2.0		5	7.3	34%	0.8
Averages-->			3.7	47%	2.2	Averages-->		3.9	33%	2.6
Mandan	Canada Wildrye	1	3.5	41%	3.3	HybriForce-420/Wet	1	1.2	28%	3.3
		2	3.6	38%	4.7		2	2.7	29%	3.5
		3	3.0	41%	3.9		3	3.4	30%	3.6
		4	4.2	40%	2.9		4	5.9	34%	2.3
		5	4.6	41%	2.6		5	7.3	44%	0.6
Averages-->			3.8	40%	3.5	Averages-->		4.1	33%	2.6
Shoshone	Manystem Wildrye	1	3.4	46%	1.0	Bullseye	1	2.3	32%	3.6
		2	4.4	36%	2.9		2	3.3	29%	3.5
		3	3.2	49%	1.2		3	3.9	29%	3.2
		4	5.5	24%	1.4		4	4.5	33%	3.1
		5	5.9	43%	3.5		5	6.3	34%	1.3
Averages-->			4.5	40%	2.0	Averages-->		4.1	32%	2.9
Alkar	Tall Wheatgrass	1	3.1	34%	4.0	Rugged	1	1.7	29%	3.1
		2	3.2	31%	5.4		2	2.7	29%	3.1
		3	5.0	35%	4.4		3	4.5	34%	3.9
		4	6.3	32%	6.0		4	5.1	34%	2.9
		5	9.2	35%	5.9		5	5.1	38%	1.0
Averages-->			5.4	33%	5.1	Averages-->		3.8	33%	2.8
Revenue	Slender Wheatgrass	1	3.1	48%	3.9	PGI427	1	2.9	31%	3.1
		2	3.3	48%	4.9		2	3.4	30%	3.2
		3	3.3	48%	3.4		3	4.0	31%	3.3
		4	4.8	49%	4.0		4	6.9	31%	2.6
		5	7.8	50%	2.3		5	6.3	35%	1.5
Averages-->			4.5	49%	3.7	Averages-->		4.7	32%	2.8
Rodan	Western Wheatgrass	1	2.3	50%	3.2	TS4002	1	2.4	31%	3.3
		2	4.1	45%	3.1		2	1.8	31%	2.8
		3	3.6	48%	1.9		3	3.9	32%	2.6
		4	4.8	46%	2.0		4	4.8	35%	2.7
		5	8.4	49%	2.0		5	8.1	35%	1.3
Averages-->			4.6	48%	2.4	Averages-->		4.2	33%	2.5
NewHy	Hybrid Wheatgrass	1	2.9	46%	3.8	CW064027	2	2.6	32%	3.1
		2	4.2	42%	3.8		3	3.9	31%	2.8
		3	3.5	43%	3.1		4	5.2	33%	1.9
		4	5.5	44%	3.0		5	7.3	36%	0.7
		5	9.1	46%	3.4		1	2.8	30%	2.7
Averages-->			5.1	44%	3.4	Averages-->		4.3	32%	2.2
AC Saltlander	Green Wheatgrass	1	2.1	44%	4.0	CW054038	2	3.2	31%	2.7
		2	4.0	44%	4.0		3	5.4	34%	2.8
		3	4.1	42%	4.3		4	5.3	38%	2.0
		4	6.9	44%	5.0		5	6.5	44%	1.4
		5	9.3	47%	2.8		1	2.3	30%	3.1
Averages-->			5.3	44%	4.0	Averages-->		4.5	35%	2.4
Saltlander Forage Grass Mix	50% AC Saltlander gwg 25% Revenue swg 25% Courtenay tff	1	2.4	41%	5.3	CW084034	1	2.3	31%	3.4
		2	3.8	40%	3.8		2	3.8	32%	2.2
		3	4.3	40%	4.1		3	4.7	31%	2.8
		4	5.4	39%	4.4		4	4.8	36%	2.2
Averages-->			4.2	41%	4.3	Averages-->		4.0	33%	2.6
O'Conner Strawberry Clover		1	2.3	29%	1.3	PGI908S	1	2.2	35%	2.4
		2	3.6	27%	1.6		2	3.6	36%	1.8
		3	3.8	30%	1.7		3	4.2	37%	1.4
		4	4.7	29%	1.0		4	6.1	38%	1.3
		5	7.0	39%	0.5		Averages-->		3.2	29%	1.4
Averages-->			4.3	31%	1.2					

Table CA-5. Buchanan Site Production Data – 2011

Grasses							Alfalfa					
Variety	Species	Plot	plants/f t2	EC	DM	Yield Dry T/acre	Variety	Plot	plants/f t2	EC	DM	Yield Dry T/acre
Garrison	Creeping Foxtail	1	29	4.5	63%	3.4	Travois	1	16	2.0	34%	2.5
		2	9	5.9	37%	2.6		2	14	2.9	33%	3.5
		3	8	4.4	36%	3.6		3	9	3.0	35%	3.0
		4	2	5.7	32%	2.5		4	5	3.7	38%	3.2
		5	2	5.2	39%	1.2		5	3	4.5	26%	1.6
Averages-->		10	5.1	41%	2.6	Averages-->		9	3.2	33%	2.8	
Lincoln	Smooth Bromegrass	1	30	4.2	32%	1.8	DS9412	1	41	0.9	34%	2.3
		2	17	4.3	51%	2.6		2	18	2.8	31%	3.5
		3	12	5.8	45%	3.7		3	13	4.8	37%	2.2
		4	5	5.2	54%	0.7		4	4	5.7	48%	0.3
		5	1	5.0	65%	0.4		5	2	6.2	0%	0.0
Averages-->		13	4.9	49%	1.9	Averages-->		16	4.1	30%	1.7	
Fleet	Meadow Bromegrass	1	20	2.5	40%	3.1	DS876	1	37	1.4	32%	3.6
		2	18	4.2	54%	1.7		2	11	3.7	35%	2.9
		3	12	3.5	51%	2.9		3	12	4.9	35%	3.4
		4	7	5.2	55%	2.7		4	5	4.8	40%	1.0
		5	1	5.5	76%	0.3		5	4	5.1	36%	0.5
Averages-->		12	4.2	55%	2.1	Averages-->		14	4.0	36%	2.3	
Mandan	Canada Wildrye	1	15	3.3	45%	2.8	HybriForce-420/Wet	1	21	0.9	30%	3.0
		2	7	3.3	41%	3.6		2	15	2.9	31%	3.2
		3	10	2.9	36%	3.8		3	12	3.3	34%	3.1
		4	4	5.1	42%	3.3		4	9	6.5	40%	1.8
		5	1	5.2	41%	2.6		5	1	6.3	63%	0.1
Averages-->		8	4.0	41%	3.2	Averages-->		12	4.0	39%	2.2	
Shoshone	Manystem Wildrye	1	26	4.0	45%	1.1	Bullseye	1	41	2.0	32%	3.1
		2	12	2.8	38%	3.9		2	14	2.7	31%	3.2
		3	9	4.3	44%	2.9		3	8	4.8	32%	3.1
		4	3	4.4	31%	3.6		4	15	3.6	37%	2.6
		5	1	5.6	45%	5.7		5	1	6.3	37%	0.6
Averages-->		10	4.2	41%	3.4	Averages-->		16	3.9	34%	2.5	
Alkar	Tall Wheatgrass	1	18	3.8	35%	5.3	Rugged	1	24	1.6	30%	3.6
		2	19	3.7	32%	5.2		2	18	2.8	31%	2.8
		3	16	3.4	38%	3.5		3	16	4.8	39%	3.5
		4	12	5.1	31%	9.4		4	6	4.4	38%	2.2
		5	11	12.1	37%	5.4		5	1	3.8	43%	0.2
Averages-->		15	5.6	35%	5.8	Averages-->		13	3.5	36%	2.4	
Revenue	Slender Wheatgrass	1	33	2.4	47%	4.5	PGI427	1	18	2.2	32%	3.2
		2	16	4.4	48%	5.3		2	15	2.6	32%	3.1
		3	11	3.3	47%	5.0		3	14	4.9	34%	3.0
		4	7	5.1	47%	7.3		4	2	7.5	37%	2.1
		5	3	8.5	49%	1.6		5	2	5.0	39%	2.1
Averages-->		14	4.7	48%	4.8	Averages-->		10	4.4	35%	2.7	
Rodan	Western Wheatgrass	1	16	2.4	38%	4.0	TS4002	1	28	2.5	33%	2.7
		2	10	5.3	44%	3.0		2	16	3.4	32%	3.0
		3	19	3.8	48%	3.4		3	14	3.9	37%	1.5
		4	21	6.0	42%	4.3		4	9	5.2	40%	1.4
		5	1	8.0	52%	0.6		5	1	7.3	41%	1.4
Averages-->		14	5.1	45%	3.1	Averages-->		14	4.4	37%	2.0	
NewHy	Hybrid Wheatgrass	1	38	3.1	45%	3.3	CW064027	1	20	2.9	35%	3.5
		2	22	5.2	46%	4.1		2	15	3.2	37%	3.5
		3	15	4.4	44%	4.0		3	8	3.7	32%	2.6
		4	6	5.6	40%	3.9		4	5	4.8	40%	0.9
		5	2	10.0	48%	2.0		5	1	5.7	42%	0.7
Averages-->		17	5.7	45%	3.5	Averages-->		10	4.1	37%	2.3	
AC Saltlander	Green Wheatgrass	1	22	1.4	48%	3.5	CW054038	1	26	2.8	35%	3.4
		2	18	5.6	46%	4.4		2	14	3.1	36%	3.1
		3	12	3.5	48%	4.3		3	7	5.7	40%	2.4
		4	7	7.1	46%	5.2		4	5	5.6	51%	0.1
		5	1	10.8	46%	2.2		5	1	4.5	70%	0.2
Averages-->		12	5.7	47%	3.9	Averages-->		11	4.4	46%	1.8	
Saltlander Forage Grass Mix	50% AC Saltlander gwg	1	38	2.4	42%	4.3	CW084034	1	19	2.6	33%	3.1
	25% Revenue swg	2	34	4.5	45%	4.4		2	16	4.8	37%	3.1
	25% Courtenay tff	3	20	5.9	40%	4.0		3	12	3.6	36%	2.8
		4	11	3.9	43%	4.6		4	6	3.9	42%	2.4
		5	3	6.1	43%	3.2		5	1	5.1	43%	1.2
Averages-->		21	4.6	42%	4.1	Averages-->		11	4.0	38%	2.5	
							PGI908S	1	13	3.6	40%	2.4
								2	12	5.2	39%	1.8
								3	6	3.6	42%	0.6
								4	2	3.6	42%	0.5
								5	1	4.4	56%	0.1
Averages-->						Averages-->		7	4.1	44%	1.1	

Table CA-6. Barlow Site Production Data – 2011

Grasses						Alfalfa/Forbs					
Variety	Plot	EC	EC2	DM	Yield	Variety	Plot	EC	EC2	DM	Yield
ACSaltlander	1	0.69	1.38	0.37	5.66	HybriForce-420/Wet	1	0.84	1.68	0.25	3.53
	2	1.51	3.02	0.37	5.33		2	1.06	2.13	0.26	3.47
	3	1.82	3.65	0.34	4.71		3	1.68	3.37	0.28	3.51
	4	3.54	7.08	0.38	4.81		4	3.08	6.16	0.32	2.43
	5	4.29	8.58	0.46	2.68		5	2.21	4.42	0.31	1.36
Average=>		2.37	4.74	0.39	4.64	Average=>		1.78	3.55	0.29	2.86
Alkar	1	1.14	2.28	0.27	3.28	Bullseye	1	1.29	2.57	0.28	3.63
	2	1.38	2.76	0.27	5.37		2	1.92	3.84	0.25	3.32
	3	1.60	3.20	0.28	5.04		3	0.81	1.63	0.25	2.96
	4	1.49	2.97	0.33	2.38		4	1.54	3.08	0.28	3.66
	5	4.60	9.20	0.34	7.08		5	2.20	4.40	0.30	1.78
Average=>		2.04	4.08	0.30	4.63	Average=>		1.55	3.10	0.27	3.07
Lincoln	1	1.31	2.62	0.29	1.84	CW054038	1	2.30	4.60	0.24	1.75
	2	1.71	3.41	0.69	7.65		2	2.60	5.20	0.25	2.50
	3	1.04	2.07	0.43	4.85		3	3.39	6.78	0.31	3.15
	4	1.35	2.70	0.45	2.50		4	2.14	4.28	0.31	2.77
	5	1.88	3.76	0.52	0.58		5	3.08	6.16	0.31	2.32
Average=>		1.46	2.91	0.47	3.48	Average=>		2.70	5.40	0.28	2.50
Mandan	1	1.20	2.40	0.38	2.78	CW064027	1	1.38	2.77	0.25	2.14
	2	0.83	1.66	0.35	4.93		2	1.76	3.52	0.25	2.52
	3	1.44	2.89	0.41	6.53		3	2.56	5.12	0.28	2.65
	4	1.23	2.47	0.40	1.62		4	1.98	3.96	0.27	1.96
	5	1.64	3.27	0.41	1.10		5	3.20	6.40	0.29	1.16
Average=>		1.27	2.54	0.39	3.39	Average=>		2.18	4.35	0.27	2.09
NewHy	1	1.15	2.30	0.40	5.05	CW084034	1	1.78	3.56	0.27	3.17
	2	0.68	1.35	0.35	4.41		2	2.43	4.86	0.27	0.73
	3	0.81	1.63	0.38	2.20		3	2.61	5.22	0.28	3.11
	4	2.37	4.74	0.45	2.09		4	2.44	4.88	0.35	1.08
	5	4.25	8.50	0.43	3.76		5	2.97	5.94	0.32	0.86
Average=>		1.85	3.70	0.40	3.50	Average=>		2.45	4.89	0.30	1.79
O'Connors	1	1.01	2.03	0.24	1.11	DS876	1	0.89	1.78	0.29	3.53
	2	0.94	1.89	0.21	1.50		2	0.90	1.80	0.30	2.74
	3	0.98	1.96	0.23	2.95		3	1.07	2.14	0.30	3.31
	4	1.44	2.89	0.29	0.91		4	2.19	4.38	0.29	1.66
	5	2.60	5.20	0.49	0.25		5	2.84	5.68	0.32	1.50
Average=>		1.40	2.79	0.29	1.34	Average=>		1.58	3.15	0.30	2.55
Shoshone	1	1.31	2.63	0.49	0.44	DS9412	1	0.74	1.48	0.30	3.61
	2	2.34	4.68	0.33	2.53		2	0.66	1.32	0.31	3.44
	3	1.39	2.77	0.57	0.13		3	0.75	1.49	0.29	2.31
	4	0.80	1.61	0.00	0.00		4	2.08	4.16	0.30	1.60
	5	2.52	5.04	0.45	0.50		5	3.00	6.00	0.28	2.47
Average=>		1.67	3.35	0.37	0.72	Average=>		1.44	2.89	0.29	2.69
Revenue	1	1.70	3.40	0.43	4.44	Rugged	1	0.88	1.75	0.26	2.70
	2	0.98	1.96	0.46	4.97		2	1.32	2.63	0.26	2.94
	3	0.67	1.34	0.41	3.10		3	1.86	3.72	0.30	4.67
	4	1.76	3.51	0.49	2.29		4	2.98	5.96	0.30	2.93
	5	4.21	8.42	0.47	3.02		5	1.86	3.71	0.31	1.96
Average=>		1.86	3.73	0.45	3.57	Average=>		1.78	3.55	0.29	3.04
Fleet	1	1.08	2.16	0.45	2.02	Travois	1	0.92	1.83	0.27	2.73
	2	1.14	2.29	0.43	3.98		2	0.70	1.41	0.33	4.35
	3	1.48	2.95	0.39	3.50		3	0.64	1.29	0.34	3.62
	4	1.27	2.53	0.48	2.98		4	2.36	4.72	0.38	2.68
	5	1.55	3.11	0.48	2.12		5	2.56	5.12	0.35	3.15
Average=>		1.30	2.61	0.44	2.92	Average=>		1.44	2.87	0.33	3.31
Garrison	1	1.22	2.44	0.42	2.98	TS4002	1	1.88	3.76	0.29	3.38
	2	1.26	2.53	0.38	2.48		2	0.68	1.36	0.32	2.31
	3	2.37	4.74	0.39	2.46		3	1.63	3.27	0.27	2.39
	4	1.83	3.66	0.41	2.47		4	1.39	2.77	0.31	3.49
	5	3.29	6.58	0.46	0.20		5	4.49	8.98	0.29	1.47
Average=>		2.00	3.99	0.41	2.12	Average=>		2.01	4.03	0.30	2.61
Rodan	1	1.22	2.43	0.41	2.90	PGI427	1	1.49	2.99	0.27	2.74
	2	0.96	1.92	0.42	2.70		2	2.30	4.60	0.27	3.14
	3	1.42	2.83	0.49	1.19		3	1.31	2.62	0.27	3.18
	4	2.82	5.64	0.48	0.71		4	3.31	6.62	0.28	2.98
	5	4.25	8.50	0.46	1.44		5	2.48	4.96	0.28	1.57
Average=>		2.13	4.27	0.45	1.79	Average=>		2.18	4.36	0.27	2.72
Saltlander Forage Grass Mix	1	1.19	2.37	0.33	7.07						
	2	0.71	1.41	0.29	3.73						
	3	0.64	1.29	0.35	4.22						
	4	2.70	5.40	0.32	3.55						
	5	4.20	8.40	0.41	4.49						
Average=>		1.89	3.77	0.34	4.61						

Table CA-7. 2011 Forage quality – Pasta Plant Site

Variety	CP	HDP	AP	NFC	ADF	NDF	CF	TDN EST.	NE/LACT MCAL/LB	NE/MAINT MCAL/LB	NE/GAINM CAL/LB	DDM	(Ca)	(P)	(K)	(Mg)	RFV	
Garrison Creeping Foxtail	1	7.80	0.71	7.80	17.53	43.63	63.35	34.91	52.80	0.53	0.48	0.23	54.91	0.60	0.25	1.99	0.25	80.63
	2	10.17	0.75	10.17	13.46	42.28	65.05	33.82	54.34	0.55	0.51	0.26	55.96	0.53	0.26	1.95	0.28	80.03
	3	9.38	0.60	9.38	19.37	39.86	59.94	31.89	57.10	0.58	0.55	0.29	57.85	0.53	0.27	2.11	0.22	89.79
	4	12.10	0.74	12.10	14.56	39.50	62.02	31.60	57.52	0.59	0.56	0.30	58.13	0.55	0.27	2.01	0.25	87.20
	5	8.21	0.73	8.21	14.15	45.25	66.32	36.20	50.96	0.51	0.46	0.21	53.65	0.50	0.26	2.23	0.21	75.25
Average-->	9.53	0.71	9.53	15.81	42.10	63.34	33.68	54.54	0.55	0.51	0.26	56.10	0.54	0.26	2.06	0.24	82.58	
Lincoln Smooth Bromegrass	1	11.68	0.59	11.68	17.25	38.39	59.74	30.71	58.78	0.60	0.58	0.32	58.99	0.64	0.25	1.96	0.27	91.85
	2	10.41	0.56	10.41	14.40	39.67	63.87	31.74	57.32	0.58	0.55	0.30	57.99	0.47	0.18	1.33	0.24	84.48
	3	7.33	0.57	7.33	19.13	40.90	62.22	32.72	55.91	0.57	0.53	0.28	57.04	0.50	0.18	1.43	0.21	85.28
	4	5.79	0.59	5.76	15.95	42.52	66.94	34.01	54.07	0.55	0.50	0.25	55.78	0.31	0.14	1.15	0.16	77.51
	5	7.40	0.54	7.40	19.15	40.12	62.13	32.10	56.80	0.58	0.55	0.29	57.64	0.39	0.16	1.21	0.18	86.31
Average-->	8.52	0.57	8.52	17.18	40.32	62.98	32.26	56.58	0.58	0.54	0.29	57.49	0.46	0.18	1.42	0.21	85.09	
Fleet Meadow Bromegrass	1	9.51	0.55	9.51	16.39	38.81	62.78	31.04	58.31	0.59	0.57	0.31	58.67	0.43	0.18	1.20	0.24	86.94
	2	6.90	0.60	6.90	16.91	40.69	64.87	32.55	56.16	0.57	0.54	0.28	57.21	0.36	0.17	1.28	0.17	82.03
	3																	
	4	6.76	0.60	6.76	18.03	40.38	63.89	32.30	56.51	0.57	0.54	0.29	57.44	0.37	0.18	1.42	0.17	83.64
	5	6.79	0.57	6.79	17.62	41.58	64.26	33.27	55.14	0.56	0.52	0.27	56.51	0.34	0.21	1.74	0.17	81.79
Average-->	7.49	0.58	7.49	17.24	40.37	63.95	32.29	56.53	0.57	0.54	0.29	57.46	0.38	0.19	1.41	0.19	83.60	
Mandan Canada Wildrye	1	5.18	0.49	5.18	14.20	44.03	69.29	35.22	52.35	0.53	0.48	0.23	54.60	0.35	0.16	1.27	0.20	73.30
	2	10.88	0.58	10.88	9.86	42.36	67.94	33.89	54.25	0.55	0.51	0.25	55.90	0.51	0.23	1.64	0.27	76.54
	3	4.65	0.54	4.52	17.36	42.59	66.67	34.07	53.99	0.55	0.50	0.25	55.73	0.38	0.14	1.08	0.15	77.75
	4	11.16	0.59	11.16	10.35	40.74	67.17	32.59	56.10	0.57	0.54	0.28	57.16	0.47	0.23	1.63	0.24	79.17
	5	6.52	0.58	6.52	11.11	44.84	71.05	35.88	51.42	0.52	0.46	0.21	53.97	0.36	0.17	1.31	0.17	70.66
Average-->	7.68	0.56	7.65	12.58	42.91	68.42	34.33	53.62	0.54	0.50	0.24	55.47	0.41	0.19	1.39	0.21	75.48	
Shoshone Manystem Wildrye	1	7.34	0.59	7.34	17.34	40.09	64.00	32.07	56.84	0.58	0.55	0.29	57.67	0.36	0.16	1.60	0.14	83.82
	2	10.80	0.72	10.80	13.67	41.16	64.22	32.93	55.62	0.56	0.53	0.27	56.83	0.53	0.25	2.08	0.21	82.33
	3	7.23	0.70	7.23	15.54	41.60	65.92	33.28	55.11	0.56	0.52	0.27	56.49	0.40	0.19	1.92	0.14	79.72
	4	16.18	0.74	16.18	11.87	36.48	60.63	29.18	60.96	0.62	0.61	0.35	60.48	0.62	0.25	2.16	0.25	92.79
	5	10.90	0.79	10.90	8.35	43.44	69.43	34.75	53.02	0.54	0.49	0.24	55.06	0.51	0.25	2.27	0.23	73.77
Average-->	10.49	0.71	10.49	13.35	40.55	64.84	32.44	56.31	0.57	0.54	0.28	57.31	0.48	0.22	2.01	0.19	82.49	
Alkar Tall Wheatgrass	1	6.25	0.55	6.25	8.32	47.62	74.11	38.10	48.25	0.48	0.41	0.17	51.80	0.29	0.20	1.73	0.18	65.03
	2	8.65	0.53	8.65	7.84	46.19	72.19	36.95	49.89	0.50	0.44	0.19	52.92	0.32	0.25	2.09	0.21	68.20
	3	6.27	0.51	6.27	6.92	47.71	75.49	38.17	48.15	0.48	0.41	0.16	51.73	0.19	0.20	1.76	0.16	63.75
	4	12.13	0.52	12.13	6.05	44.55	70.50	35.64	51.75	0.52	0.47	0.22	54.19	0.41	0.29	2.24	0.29	71.50
	5	6.50	0.54	6.50	7.29	47.68	74.89	38.15	48.18	0.48	0.41	0.16	51.76	0.26	0.23	1.92	0.18	64.28
Average-->	7.96	0.53	7.96	14.57	46.75	73.44	37.40	49.24	0.49	0.43	0.18	52.48	0.29	0.23	1.95	0.20	66.55	
Revenue Slender Wheatgrass	1	5.85	0.62	5.80	8.73	45.91	74.10	36.73	50.20	0.50	0.44	0.19	53.13	0.23	0.11	0.96	0.14	66.70
	2	10.31	0.77	10.31	7.63	43.21	70.74	34.57	53.29	0.54	0.49	0.24	55.24	0.39	0.21	1.51	0.21	72.64
	3	6.20	0.66	6.13	10.51	45.16	71.98	36.13	51.06	0.51	0.46	0.21	53.72	0.31	0.12	0.98	0.14	69.43
	4	5.23	0.68	4.97	8.70	47.44	74.75	37.95	48.46	0.49	0.42	0.17	51.95	0.26	0.13	1.13	0.10	64.64
	5	7.30	0.67	7.30	7.93	44.56	73.45	35.64	51.75	0.52	0.47	0.22	54.19	0.30	0.14	1.16	0.15	68.63
Average-->	6.98	0.68	6.90	8.70	45.26	73.00	36.20	50.95	0.51	0.46	0.21	53.65	0.30	0.14	1.15	0.15	68.41	
Rodan Western Wheatgrass	1	6.40	0.52	6.40	15.66	41.83	66.62	33.47	54.85	0.56	0.52	0.26	56.31	0.33	0.13	0.98	0.13	78.63
	2	8.00	0.51	8.00	13.70	41.27	66.97	33.02	55.50	0.56	0.53	0.27	56.75	0.28	0.15	1.22	0.15	78.83
	3	10.00	0.48	10.00	15.43	39.31	63.25	31.45	57.73	0.59	0.56	0.30	58.28	0.43	0.19	1.33	0.18	85.71
	4	6.76	0.50	6.76	18.72	40.35	63.21	32.28	56.55	0.58	0.54	0.29	57.47	0.44	0.17	1.20	0.17	84.58
	5	8.78	0.45	8.78	14.69	39.84	65.21	31.87	57.13	0.58	0.55	0.30	57.87	0.40	0.16	1.21	0.21	82.54
Average-->	7.99	0.49	7.99	15.64	40.52	65.05	32.42	56.35	0.57	0.54	0.28	57.34	0.38	0.16	1.19	0.17	82.06	
NewHy Hybrid Wheatgrass	1	5.30	0.51	5.30	18.50	43.32	64.88	34.65	53.16	0.54	0.49	0.24	55.16	0.38	0.15	1.28	0.15	79.09
	2	7.18	0.54	7.18	18.59	40.67	62.91	32.54	56.18	0.57	0.54	0.28	57.22	0.43	0.19	1.53	0.19	84.60
	3	10.66	0.57	10.66	15.30	39.87	62.71	31.90	57.09	0.58	0.55	0.29	57.84	0.50	0.23	1.74	0.24	85.80
	4	9.97	0.55	9.97	16.49	40.04	62.22	32.03	56.90	0.58	0.55	0.29	57.71	0.48	0.22	1.63	0.23	86.29
	5	5.81	0.58	5.81	15.08	44.15	67.79	35.32	52.21	0.53	0.48	0.22	54.51	0.31	0.18	1.58	0.15	74.79
Average-->	7.78	0.55	7.78	16.79	41.61	64.10	33.29	55.11	0.56	0.52	0.26	56.49	0.42	0.19	1.55	0.19	82.11	
AC Saltlander Green Wheatgrass	1	5.80	0.57	5.80	16.85	43.74	66.03	34.99	52.68	0.53	0.48	0.23	54.83	0.36	0.17	1.46	0.15	77.24
	2	6.13	0.54	6.13	18.47	41.80	64.08	33.44	54.89	0.56	0.52	0.26	56.34	0.42	0.16	1.28	0.17	81.78
	3	10.68	0.64	10.68	16.14	40.01	61.85	32.01	56.93	0.58	0.55	0.29	57.73	0.62	0.24	1.64	0.27	86.82
	4	10.61	0.64	10.61	14.54	40.36	63.53	32.29	56.53	0.58	0.54	0.29	57.46	0.56	0.22	1.38	0.26	84.13
	5	8.30	0.59	8.30	14.40	42.17	65.98	33.74	54.46	0.55	0.51	0.26	56.05	0.44	0.22	1.62	0.20	79.02
Average-->	8.30	0.60	8.30	16.08	41.62	64.29	33											

Table CA-8. 2011 Forage Quality – Buchanan Site

Variety	CP	HDP	AP	NFC	ADF	NDF	CF	TDN EST.	NE/LACT MCAL/LB	NE/MAIN T MCAL/LB	NE/GAIN MCAL/LB	DDM	(Ca)	(P)	(K)	(Mg)	RFV	
Garrison Creeping Foxtail	1	3.94	0.63	3.55	20.21	44.75	64.53	35.80	51.52	0.52	0.46	0.21	54.04	0.34	0.15	1.50	0.09	77.89
	2	5.61	0.69	5.41	16.17	46.26	66.90	37.01	49.81	0.50	0.44	0.19	52.86	0.40	0.20	1.78	0.16	73.51
	3	7.93	0.77	7.93	13.67	45.51	67.08	36.41	50.66	0.51	0.45	0.20	53.45	0.49	0.23	2.07	0.20	74.12
	4	12.29	0.90	12.29	10.04	44.28	66.35	35.42	52.06	0.53	0.47	0.22	54.41	0.58	0.27	1.94	0.27	76.28
	5	3.33	0.60	2.90	19.09	45.33	66.26	36.26	50.87	0.51	0.45	0.20	53.59	0.31	0.13	1.39	0.10	75.23
Average-->	6.62	0.72	6.42	15.84	45.23	66.22	36.18	50.98	0.51	0.45	0.20	53.67	0.42	0.20	1.74	0.16	75.41	
Lincoln Smooth Bromegrass	1	5.67	0.56	5.67	21.94	40.89	61.07	32.71	55.93	0.57	0.53	0.28	57.04	0.56	0.11	1.05	0.18	86.89
	2	4.76	0.46	4.76	21.03	39.39	62.89	31.51	57.64	0.59	0.56	0.30	58.22	0.36	0.08	0.90	0.14	86.11
	3	9.52	0.57	9.52	15.14	39.18	64.02	31.35	57.88	0.59	0.56	0.31	58.38	0.47	0.15	1.20	0.24	84.83
	4	4.68	0.48	4.67	22.99	37.47	61.00	29.98	59.83	0.61	0.59	0.33	59.71	0.39	0.07	0.85	0.14	91.05
	5	5.29	0.46	5.29	25.34	35.42	58.05	28.34	62.17	0.64	0.63	0.36	61.31	0.41	0.07	0.66	0.16	98.24
Average-->	5.98	0.51	5.98	21.29	38.47	61.41	30.78	58.69	0.60	0.57	0.32	58.93	0.44	0.10	0.93	0.17	89.42	
Fleet Meadow Bromegrass	1	5.78	0.58	5.78	15.30	47.62	67.59	38.10	48.25	0.48	0.41	0.17	51.80	0.46	0.18	1.93	0.16	71.29
	2	4.63	0.67	4.30	15.19	43.78	68.86	35.02	52.64	0.53	0.48	0.23	54.80	0.33	0.13	1.27	0.14	74.03
	3	7.74	0.74	7.74	15.94	41.07	64.99	32.85	55.73	0.57	0.53	0.28	56.91	0.49	0.15	1.14	0.21	81.45
	4	8.12	0.79	8.12	11.72	41.22	68.84	32.97	55.56	0.56	0.53	0.27	56.79	0.43	0.17	1.17	0.21	76.74
	5	6.23	0.80	5.95	11.54	40.41	70.91	32.32	56.48	0.57	0.54	0.29	57.42	0.30	0.11	0.77	0.19	75.33
Average-->	6.50	0.72	6.38	13.94	42.82	68.24	34.25	53.73	0.54	0.50	0.25	55.54	0.40	0.15	1.26	0.18	75.77	
Mandan Canada Wildrye	1	6.57	0.54	6.57	12.35	43.08	69.76	34.46	53.43	0.54	0.49	0.24	55.34	0.37	0.17	1.25	0.19	73.80
	2	7.12	0.53	7.12	10.63	44.15	70.94	35.32	52.22	0.53	0.48	0.22	54.51	0.39	0.16	1.26	0.21	71.48
	3	10.20	0.54	10.20	10.18	43.71	68.30	34.96	52.72	0.53	0.48	0.23	54.85	0.48	0.22	1.60	0.25	74.71
	4	6.00	0.59	6.00	10.66	44.58	72.02	35.67	51.72	0.52	0.47	0.22	54.17	0.38	0.14	1.16	0.17	69.97
	5	10.38	0.55	10.38	10.37	41.26	67.93	33.01	55.51	0.56	0.53	0.27	56.76	0.43	0.17	1.38	0.25	77.72
Average-->	8.05	0.55	8.05	10.84	43.36	69.79	34.68	53.12	0.54	0.49	0.24	55.13	0.41	0.17	1.33	0.21	73.54	
Shoshone Manystem Wildrye	1	6.12	0.62	6.11	13.55	45.17	69.01	36.14	51.05	0.51	0.46	0.21	53.71	0.29	0.20	2.13	0.12	72.40
	2	12.95	0.73	12.95	9.05	43.33	66.68	34.66	53.15	0.54	0.49	0.24	55.15	0.51	0.26	2.36	0.24	76.93
	3	4.97	0.71	4.63	10.57	46.96	73.14	37.56	49.01	0.49	0.42	0.18	52.32	0.30	0.18	1.94	0.13	66.54
	4	7.43	0.76	7.40	8.10	46.15	73.15	36.92	49.93	0.50	0.44	0.19	52.95	0.35	0.21	2.02	0.17	67.34
	5	9.27	0.70	9.27	6.50	46.33	72.91	37.06	49.73	0.50	0.44	0.19	52.81	0.34	0.24	2.21	0.20	67.38
Average-->	8.15	0.70	8.07	9.55	45.59	70.98	36.47	50.57	0.51	0.45	0.20	53.39	0.36	0.22	2.13	0.17	70.12	
Alkar Tall Wheatgrass	1	8.23	0.51	8.23	5.62	47.69	74.82	38.15	48.17	0.48	0.41	0.16	51.75	0.22	0.24	1.99	0.18	64.33
	2	9.12	0.51	9.12	5.21	48.88	74.35	39.10	46.82	0.47	0.39	0.14	50.83	0.27	0.26	2.26	0.20	63.59
	3	4.86	0.53	4.80	6.66	49.30	77.16	39.44	46.33	0.46	0.38	0.14	50.49	0.19	0.19	1.81	0.14	60.87
	4	11.76	0.60	11.76	6.60	46.66	70.32	37.33	49.34	0.49	0.43	0.18	52.55	0.37	0.29	2.35	0.27	69.51
	5	12.11	0.46	12.11	5.72	43.86	70.84	35.09	52.54	0.53	0.48	0.23	54.73	0.32	0.28	2.25	0.25	71.87
Average-->	9.22	0.52	9.20	5.96	47.28	73.50	37.82	48.64	0.49	0.42	0.17	52.07	0.27	0.25	2.13	0.21	66.03	
Revenue Slender Wheatgrass	1	6.74	0.75	6.62	5.21	49.81	76.73	39.84	45.76	0.46	0.37	0.13	50.10	0.37	0.16	1.44	0.16	60.74
	2	8.94	0.65	8.94	8.64	45.55	71.10	36.44	50.62	0.51	0.45	0.20	53.42	0.43	0.19	1.45	0.22	69.89
	3	9.07	0.72	9.07	0.00	47.09	73.97	37.67	48.86	0.49	0.42	0.17	52.22	0.43	0.18	1.65	0.22	65.66
	4	11.34	0.72	11.34	7.76	44.31	69.59	35.45	52.03	0.52	0.47	0.22	54.38	0.49	0.20	1.28	0.26	72.70
	5	11.57	0.65	11.57	6.89	42.40	70.22	33.92	54.21	0.55	0.51	0.25	55.87	0.45	0.18	1.33	0.26	74.02
Average-->	9.53	0.70	9.51	5.70	45.83	72.32	36.66	50.30	0.51	0.44	0.19	53.20	0.43	0.18	1.43	0.22	68.60	
Rodan Western Wheatgrass	1	11.09	0.59	11.09	9.86	43.86	67.73	35.08	52.55	0.53	0.48	0.23	54.74	0.50	0.26	2.00	0.24	75.17
	2	11.33	0.53	11.33	10.26	40.92	67.09	32.73	55.90	0.57	0.53	0.28	57.03	0.41	0.21	1.47	0.22	79.07
	3	6.39	0.55	6.39	13.81	43.00	68.48	34.40	53.53	0.54	0.50	0.24	55.41	0.40	0.14	1.16	0.16	75.26
	4	10.18	0.62	10.18	9.95	42.70	68.55	34.16	53.86	0.55	0.50	0.25	55.64	0.44	0.20	1.50	0.26	75.50
	5	11.63	0.51	11.63	14.61	37.62	62.45	30.09	59.66	0.61	0.59	0.33	59.60	0.52	0.19	1.19	0.26	88.78
Average-->	10.12	0.56	10.12	11.70	41.62	66.86	33.29	55.10	0.56	0.52	0.27	56.48	0.45	0.20	1.46	0.23	78.76	
NewHy Hybrid Wheatgrass	1	8.01	0.66	8.01	12.94	44.88	67.74	35.90	51.38	0.52	0.46	0.21	53.94	0.46	0.22	1.81	0.21	74.07
	2	6.70	0.63	6.70	16.01	44.65	65.97	35.72	51.64	0.52	0.47	0.22	54.12	0.43	0.17	1.44	0.18	76.31
	3	10.91	0.67	10.91	9.98	43.75	67.80	35.00	52.67	0.53	0.48	0.23	54.82	0.52	0.24	2.03	0.26	75.22
	4	11.08	0.66	11.08	10.61	43.43	66.98	34.74	53.04	0.54	0.49	0.24	55.07	0.54	0.25	1.86	0.29	76.48
	5	11.32	0.60	11.32	14.70	39.15	62.67	31.32	57.91	0.59	0.56	0.31	58.40	0.49	0.22	1.57	0.25	86.69
Average-->	9.60	0.64	9.60	12.85	43.17	66.23	34.54	53.33	0.54	0.49	0.24	55.27	0.49	0.22	1.74	0.24	77.75	
AC Saltlander Green Wheatgrass	1	7.98	0.78	7.98	9.64	46.23	71.07	36.99	49.84	0.50	0.44	0.19	52.89	0.42	0.20	1.76	0.20	69.22
	2	7.65	0.51	7.65	22.20	38.69	58.83	30.95	58.44	0.60	0.57	0.31	58.76	0.55	0.18	1.43	0.22	92.92
	3	8.02	0.66	8.02	16.53	42.31	64.13	33.85	54.31	0.55	0.51	0.25	55.94	0.50	0.19	1.53	0.20	81.14
	4	10.54	0.56	10.54	17.50	38.45	60.64	30.76	58.71	0.60	0.58	0.32	58.94	0.56	0.19	1.49	0.25	90.43
	5	11.83	0.54	11.83	13.67	39.08	63.18	31.26	58.00	0.59	0.56	0.31	58.46	0.52	0.23	1.49	0.27	86.07
Average-->																		

Table CA-9. 2011 Forage Quality – Barlow Site

Variety	CP	HDP	AP	NFC	ADF	NDF	CF	TDN EST.	NE/LACTM CAL/LB	NE/MAINT MCAL/LB	NE/GAINM CAL/LB	DDM	(Ca)	(P)	(K)	(Mg)	RFV	
Garrison Creeping Foxtail	1	5.36	0.67	5.15	16.47	46.45	66.85	37.16	49.58	0.50	0.43	0.19	52.71	0.35	0.22	2.07	0.11	73.35
	2	11.02	0.77	11.02	13.60	42.54	64.05	34.04	54.04	0.55	0.50	0.25	55.76	0.48	0.27	2.14	0.23	80.97
	3	10.25	0.74	10.25	11.62	43.41	66.81	34.73	53.05	0.54	0.49	0.24	55.08	0.50	0.21	1.94	0.26	76.69
	4	4.37	0.61	4.09	19.02	45.18	65.29	36.15	51.03	0.51	0.46	0.21	53.70	0.38	0.18	1.81	0.13	76.51
	5	11.70	0.77	11.70	12.08	42.98	64.90	34.39	53.54	0.54	0.50	0.24	55.42	0.55	0.26	2.12	0.29	79.43
Average-->	8.54	0.71	8.44	14.56	44.11	65.58	35.29	52.25	0.53	0.48	0.23	54.53	0.45	0.23	2.02	0.20	77.39	
Lincoln Smooth Bromegrass	1	5.71	0.51	5.71	17.82	43.27	65.15	34.61	53.22	0.54	0.49	0.24	55.20	0.41	0.13	1.38	0.16	78.81
	2	6.02	0.57	6.02	12.70	46.42	69.96	37.14	49.62	0.50	0.43	0.19	52.74	0.34	0.16	1.47	0.16	70.12
	3	8.27	0.68	8.27	12.42	44.95	67.98	35.96	51.30	0.52	0.46	0.21	53.88	0.46	0.20	1.74	0.21	73.73
	4	5.70	0.62	5.61	14.64	46.47	68.34	37.18	49.56	0.50	0.43	0.19	52.70	0.41	0.17	1.57	0.17	71.74
	5	9.40	0.62	9.40	14.57	39.65	64.71	31.72	57.34	0.58	0.55	0.30	58.01	0.45	0.13	1.16	0.21	83.40
Average-->	7.02	0.60	7.00	14.43	44.15	67.23	35.32	52.21	0.53	0.47	0.23	54.51	0.41	0.16	1.46	0.18	75.56	
Fleet Meadow Bromegrass	1	7.34	0.58	7.34	18.95	40.22	62.39	32.18	56.69	0.58	0.54	0.29	57.57	0.47	0.16	1.57	0.18	85.83
	2	6.54	0.58	6.54	16.69	43.49	65.45	34.79	52.96	0.54	0.49	0.24	55.02	0.42	0.17	1.54	0.17	78.20
	3	8.38	0.51	8.38	12.20	44.20	68.10	35.36	52.15	0.53	0.47	0.22	54.47	0.37	0.20	1.92	0.19	74.40
	4	5.42	0.65	5.26	14.49	45.63	68.77	36.51	50.52	0.51	0.45	0.20	53.35	0.37	0.16	1.64	0.14	72.17
	5	6.73	0.64	6.73	14.41	43.17	67.55	34.53	53.33	0.54	0.49	0.24	55.27	0.34	0.16	1.43	0.16	76.12
Average-->	6.88	0.59	6.85	15.35	43.34	66.45	34.67	53.13	0.54	0.49	0.24	55.14	0.39	0.17	1.62	0.17	77.34	
Mandan Canada Wildrye	1	6.49	0.57	6.49	14.40	43.80	67.79	35.04	52.60	0.53	0.48	0.23	54.78	0.45	0.18	1.42	0.18	75.17
	2	10.82	0.62	10.82	10.61	44.08	67.24	35.26	52.30	0.53	0.48	0.23	54.57	0.57	0.22	1.74	0.27	75.49
	3	7.04	0.65	7.04	9.81	48.15	71.83	38.52	47.64	0.48	0.40	0.16	51.39	0.47	0.18	1.66	0.21	66.55
	4	6.07	0.55	6.07	12.54	45.35	70.08	36.28	50.84	0.51	0.45	0.20	53.57	0.38	0.14	1.20	0.17	71.11
	5	9.58	0.55	9.58	13.16	42.06	65.94	33.65	54.60	0.55	0.51	0.26	56.14	0.49	0.19	1.44	0.21	79.19
Average-->	8.00	0.59	8.00	12.10	44.69	68.58	35.75	51.60	0.52	0.46	0.22	54.09	0.47	0.18	1.49	0.21	73.50	
Shoshone Manystem Wildrye	1	7.27	0.62	7.27	15.31	42.83	66.10	34.26	53.72	0.54	0.50	0.25	55.54	0.39	0.18	1.80	0.15	78.16
	2	14.69	0.66	14.69	10.29	40.64	63.70	32.51	56.22	0.57	0.54	0.28	57.24	0.59	0.28	2.39	0.30	83.60
	3	7.62	0.71	7.62	16.83	42.47	64.23	33.97	54.13	0.55	0.51	0.25	55.82	0.45	0.17	1.77	0.14	80.84
	4																	
	5	6.74	0.69	6.71	12.09	45.69	69.85	36.55	50.46	0.51	0.45	0.20	53.31	0.32	0.18	1.81	0.13	70.99
Average-->	9.08	0.67	9.07	13.63	42.91	65.97	34.32	53.63	0.54	0.50	0.25	55.48	0.44	0.20	1.94	0.18	78.40	
Alkar Tall Wheatgrass	1	10.29	0.52	10.29	6.82	46.87	71.56	37.50	49.11	0.49	0.43	0.18	52.39	0.36	0.25	2.19	0.22	68.10
	2	11.31	0.44	11.31	6.35	45.74	71.01	36.59	50.40	0.51	0.45	0.20	53.27	0.30	0.24	2.21	0.21	69.78
	3	11.58	0.60	11.58	9.11	45.55	67.99	36.44	50.61	0.51	0.45	0.20	53.42	0.42	0.25	2.12	0.25	73.08
	4	7.53	0.46	7.53	9.38	45.45	71.77	36.36	50.73	0.51	0.45	0.20	53.50	0.22	0.20	1.74	0.16	69.34
	5	12.24	0.56	12.24	7.94	44.79	68.50	35.83	51.48	0.52	0.46	0.21	54.01	0.46	0.28	2.30	0.30	73.35
Average-->	10.59	0.52	10.59	7.92	45.68	70.17	36.54	50.47	0.51	0.45	0.20	53.32	0.35	0.24	2.11	0.23	70.73	
Revenue Slender Wheatgrass	1	7.42	0.68	7.42	8.20	48.49	73.05	38.80	47.26	0.47	0.40	0.15	51.12	0.39	0.17	1.64	0.17	65.10
	2	6.72	0.68	6.71	10.14	47.33	71.81	37.86	48.58	0.49	0.42	0.17	52.03	0.39	0.15	1.43	0.15	67.40
	3	12.67	0.67	12.67	9.70	43.87	66.31	35.10	52.53	0.53	0.48	0.23	54.73	0.58	0.25	1.95	0.26	76.78
	4	6.04	0.65	5.97	12.35	46.02	70.29	36.81	50.08	0.50	0.44	0.19	53.05	0.41	0.17	1.38	0.14	70.21
	5	10.83	0.69	10.83	7.03	44.47	70.82	35.58	51.85	0.52	0.47	0.22	54.26	0.45	0.21	1.61	0.24	71.27
Average-->	8.74	0.67	8.72	9.48	46.04	70.46	36.83	50.06	0.50	0.44	0.19	53.04	0.44	0.19	1.60	0.19	70.15	
Rodan Western Wheatgrass	1	13.15	0.69	13.15	9.56	42.40	65.97	33.92	54.21	0.55	0.51	0.25	55.87	0.59	0.28	1.84	0.27	78.78
	2	11.01	0.62	11.01	9.66	45.42	68.01	36.34	50.76	0.51	0.45	0.20	53.52	0.53	0.24	1.77	0.25	73.20
	3	10.40	0.55	10.40	12.93	42.82	65.35	34.26	53.72	0.54	0.50	0.25	55.54	0.46	0.21	1.48	0.19	79.06
	4	7.09	0.57	7.09	11.19	44.45	70.40	35.56	51.87	0.52	0.47	0.22	54.27	0.35	0.18	1.32	0.17	71.71
	5	10.38	0.57	10.38	9.15	41.74	69.15	33.39	54.96	0.56	0.52	0.26	56.38	0.37	0.18	1.35	0.20	75.85
Average-->	10.41	0.60	10.41	10.50	43.37	67.78	34.69	53.10	0.54	0.49	0.24	55.12	0.46	0.22	1.55	0.22	75.72	
NewHy Hybrid Wheatgrass	1	10.38	0.62	10.38	12.33	44.03	65.97	35.22	52.35	0.53	0.48	0.23	54.60	0.54	0.23	1.76	0.25	77.00
	2	10.49	0.79	10.49	8.72	47.00	69.47	37.60	48.96	0.49	0.42	0.18	52.29	0.57	0.25	1.91	0.28	70.02
	3	7.21	0.75	7.17	9.98	48.66	71.49	38.92	47.07	0.47	0.39	0.15	51.00	0.42	0.21	1.80	0.20	66.36
	4	9.86	0.72	9.86	10.71	45.05	68.11	36.04	51.18	0.52	0.46	0.21	53.80	0.50	0.23	1.80	0.25	73.48
	5	10.43	0.78	10.43	9.22	44.19	69.03	35.35	52.16	0.53	0.47	0.22	54.47	0.54	0.23	1.72	0.29	73.41
Average-->	9.67	0.73	9.67	10.19	45.79	68.81	36.63	50.34	0.51	0.44	0.20	53.23	0.51	0.23	1.80	0.25	72.05	
AC Saltlander Green Wheatgrass	1	8.56	0.81	8.56	13.13	45.80	66.99	36.64	50.33	0.51	0.45	0.20	53.22	0.45	0.21	1.80	0.21	73.90
	2	11.07	0.70	11.07	11.66	44.58	65.95	35.66	51.72	0.52	0.47	0.22	54.17	0.54	0.22	1.83	0.27	76.41
	3	10.37	0.71	10.37	10.84	45.58	67.47	36.46	50.58	0.51	0.45	0.20	53.40	0.58	0.26	2.20	0.29	73.61
	4	11.02	0.68	11.02	11.01	43.61	66.66	34.89	52.82	0.53	0.48	0.23	54.92	0.59	0.26	1.89	0.28	76.65
	5	11.45	0.70	11.45	12.59	41.60	64.64	33.28	55.11	0.56	0.52	0.27	56.49	0.57	0.23	1.62	0.29	81.29
Average-->	10.49	0.72	10.49	11.85	44.23	66.34	35.39	52.11										

Table CA-10. 2011 Pasta Plant Site Clipping Results - Grasses

Variety	Species	Plot	EC 1:1 @ 3"	EC 1:1 @ 6"	DM	Yield Dry T/A	Variety	Species	Plot	EC 1:1 @ 3"	EC 1:1 @ 6"	DM	Yield Dry T/A
Garrison	Creeping Foxtail	1	6	7.38	46%	2.70	Revenue	Slender Wheatgrass	1	3	3.54	56%	2.90
		2	7	5.92	52%	2.18			2	7	7.12	54%	3.15
		3	8	6.02	59%	2.18			3	6	7.46	55%	3.26
		4	5	5.92	67%	2.48			4	8	7.62	55%	2.66
		5	6	8.52	42%	2.82			5	7	9.60	56%	3.62
Averages=>			6.4	6.8	53%	2.47	Averages=>			6.0	7.1	55%	3.12
Lincoln	Smooth Bromegrass	1	5	4.96	57%	2.26	Rodan	Western Wheatgrass	1	3	3.80	58%	2.90
		2	8	7.30	56%	2.53			2	7	7.46	55%	2.95
		3	7	4.86	78%	2.87			3	11	9.80	52%	2.42
		4	5	5.78	55%	2.97			4	7	7.74	64%	3.26
		5	9	4.38	58%	2.73			5	8	6.34	57%	2.80
Averages=>			6.7	5.5	61%	2.67	Averages=>			7.1	7.0	57%	2.87
Fleet	Meadow Bromegrass	1	5	4.70	80%	3.84	NewHy	Green Wheatgrass	1	2	2.13	61%	2.83
		2	6	6.82	84%	2.97			2	5	6.26	68%	3.26
		3	6	4.32	84%	2.97			3	8	9.28	55%	3.04
		4	5	5.28	66%	2.67			4	8	6.02	66%	3.14
		5	7	4.92	77%	2.74			5	6	6.36	62%	2.95
Averages=>			5.8	5.2	78%	3.04	Averages=>			5.8	6.0	62%	3.04
Mandan	Canada Wildrye	1	6	5.44	49%	3.23	AC Saltlander	Green Wheatgrass	1	2	2.33	59%	2.87
		2	7	6.66	59%	3.00			2	6	6.34	59%	3.17
		3	5	5.64	76%	2.78			3	9	8.40	59%	3.28
		4	6	5.74	52%	3.06			4	9	4.80	59%	2.60
		5	6	5.38	51%	2.35			5	5	4.46	60%	2.63
Averages=>			5.9	5.8	58%	2.88	Averages=>			6.1	5.3	59%	2.91
Shoshone	Manystem Wildrye	1	3	4.90	56%	2.86	GrassMix	Saltlander Forage Mix 50% AC Saltlander gwg 25% Revenue swg	1	3	2.91	55%	2.96
		2	9	8.52	57%	3.79			2	5	8.08	65%	3.88
		3	6	9.88	45%	2.41			3	9	4.82	56%	2.74
		4	8	8.72	57%	3.57			4	10	8.98	63%	2.96
		5	5	6.98	58%	3.80			5	6	3.85	74%	3.53
Averages=>			6.1	7.8	55%	3.29	Averages=>			6.6	5.7	63%	3.22
Alkar	Tall Wheatgrass	1	5	2.90	43%	2.63							
		2	8	8.56	62%	4.20							
		3	8	12.44	44%	3.14							
		4	6	6.70	44%	3.05							
		5	6	7.14	42%	2.64							
Averages=>			6.5	7.5	47%	3.13							

Table CA-11. 2011 Pasta Plant Site Clipping Results- Alfalfa

Alfalfa Varieties	Plot	EC 1:1 @ 3"	1st Cutting			2nd Cutting				Total Yield Dry T/A	Alfalfa Varieties	Plot	EC 1:1 @ 3"	1st Cutting			2nd Cutting				Total Yield Dry T/A
			EC 1:1 @ 6"	DM	Yield Dry T/A	EC 1:1 @ 3"	EC 1:1 @ 6"	DM	Yield Dry T/A					EC 1:1 @ 3"	EC 1:1 @ 6"	DM	Yield Dry T/A	EC 1:1 @ 3"	EC 1:1 @ 6"	DM		Yield Dry T/A
Travois	1	3.0	3.1	30%	2.36	1.4	1.6	33%	1.0	3.4	TS4002	1	2.4	4.9	30%	2.37	0.9	2.4	34%	1.0	3.4
	2	6.8	6.6	33%	2.57	5.5	5.5	39%	1.3	3.8		2	5.2	5.5	41%	2.65	1.0	1.4	38%	1.0	3.7
	3	8.7	8.8	34%	1.82	5.6	6.6	41%	1.1	2.9		3	7.1	6.6	31%	2.42	6.4	7.2	28%	0.9	3.3
	4	9.5	10.2	33%	2.05	5.8	6.3	34%	0.9	3.0		4	8.1	7.7	30%	2.40	4.8	4.7	34%	1.0	3.4
	5	11.2	11.0	34%	1.28	10.5	10.1	39%	0.8	2.0		5	10.0	10.6	32%	1.25	8.7	8.5	42%	0.8	2.1
Averages=>		7.8	7.9	33%	2.02	5.8	6.0	37%	1.02	3.04	Averages=>		6.6	7.1	33%	2.22	4.4	4.8	35%	0.95	3.17
DS9412	1	2.5	3.0	35%	2.77	1.7	1.8	32%	1.0	3.8	CW064027	1	0.6	0.9	31%	2.34	3.7	0.6	34%	1.0	3.4
	2	6.4	6.4	29%	2.35	5.6	4.7	32%	1.2	3.6		2	2.7	3.2	33%	1.79	1.1	1.3	33%	0.9	2.7
	3	6.7	6.8	31%	2.59	2.9	5.3	35%	1.1	3.6		3	6.4	6.6	28%	2.00	6.6	12.2	33%	1.1	3.1
	4	7.4	7.4	30%	2.29	5.7	5.9	34%	1.0	3.3		4	6.6	6.5	27%	1.88	5.5	5.3	31%	1.1	3.0
	5	10.4	11.4	35%	1.33	8.6	8.6	43%	0.1	1.4		5	10.0	10.4	34%	0.12	9.1	9.9	44%	0.1	0.2
Averages=>		6.7	7.0	32%	2.27	4.9	5.2	35%	0.88	3.15	Averages=>		5.3	5.5	31%	1.62	5.2	5.9	35%	0.86	2.49
DS876	1	2.7	2.2	31%	2.48	1.2	1.2	34%	1.0	3.5	CW054038	1	0.6	0.6	29%	2.09	3.2	0.0	37%	1.0	3.1
	2	5.8	7.1	29%	2.04	4.4	5.4	32%	1.1	3.1		2	4.9	5.4	33%	1.81	0.8	1.0	35%	0.9	2.7
	3	6.2	6.9	28%	2.26	5.4	5.8	37%	1.0	3.3		3	6.5	6.9	28%	1.68	6.4	5.9	35%	1.0	2.7
	4	7.7	7.7	30%	2.24	6.4	5.7	29%	0.9	3.2		4	8.5	8.3	30%	1.83	7.3	7.0	33%	1.0	2.8
	5	11.0	13.5	49%	1.70	8.1	8.3	36%	0.8	2.5		5	11.7	7.3	35%	0.14	12.4	12.2	51%	0.1	0.2
Averages=>		6.7	7.5	33%	2.14	5.1	5.3	34%	0.97	3.11	Averages=>		6.4	5.7	31%	1.51	6.0	5.2	38%	0.80	2.31
HybriForce-420/Wet	1	2.0	2.3	31%	2.69	0.7	1.5	32%	1.0	3.7	CW084034	1	0.7	1.0	31%	1.41	3.1	0.0	31%	0.8	2.2
	2	7.6	7.9	31%	2.33	6.4	5.7	36%	1.1	3.4		2	4.5	5.0	31%	1.77	1.1	2.6	31%	0.8	2.5
	3	7.8	7.6	32%	2.43	5.4	6.3	35%	1.0	3.4		3	6.9	7.1	30%	1.45	2.8	3.8	36%	1.0	2.4
	4	6.8	7.9	30%	2.17	4.8	5.9	31%	0.8	3.0		4	7.8	7.4	31%	1.26	6.1	6.0	37%	1.2	2.4
	5	12.6	11.8	58%	0.07	7.6	8.6	44%	0.1	0.2		5	9.6	11.1	42%	0.10	9.7	9.7	49%	0.1	0.2
Averages=>		7.4	7.5	36%	1.94	5.0	5.6	35%	0.80	2.73	Averages=>		5.9	6.3	33%	1.20	4.6	4.4	37%	0.76	1.96
Bullseye	1	3.0	4.4	31%	2.50	1.7	1.8	32%	1.1	3.6	PGI908S	1	0.4	0.5	28%	2.23	3.7	0.0	39%	0.9	3.1
	2	6.9	5.8	34%	2.69	5.1	4.8	34%	1.1	3.8		2	2.2	3.4	33%	1.94	0.7	0.0	35%	1.0	2.9
	3	7.1	7.7	31%	2.31	6.4	5.7	29%	0.9	3.2		3	2.6	4.9	33%	2.47	0.0	0.0	39%	0.9	3.4
	4	7.8	8.4	31%	2.62	5.0	5.3	30%	0.9	3.5		4	6.6	7.1	26%	2.06	3.3	2.3	36%	0.9	2.9
	5	10.8	11.2	61%	0.07	6.2	5.9	55%	0.1	0.1		5	7.9	9.0	26%	1.23	8.3	8.6	48%	0.1	1.3
Averages=>		7.1	7.5	38%	2.04	4.9	4.7	36%	0.84	2.87	Averages=>		3.9	5.0	29%	1.98	3.2	2.2	40%	0.74	2.72
Rugged	1	4.3	4.8	29%	2.41	1.9	2.6	29%	1.0	3.4	O'Connors	1	10.8	2.6	33%	1.40					
	2	6.4	6.9	29%	2.23	4.9	6.0	33%	1.1	3.3		2	6.1	5.4	33%	1.76					
	3	7.8	7.8	29%	2.14	6.4	6.5	33%	1.1	3.2		3	8.1	5.6	37%	0.49					
	4	8.5	7.7	29%	2.24	5.2	4.9	33%	1.2	3.5		4	0.0	6.4	29%	1.10					
	5	10.9	10.6	35%	1.36	7.7	7.7	43%	0.8	2.2		5	3.4	8.8	28%	0.76					
Averages=>		7.6	7.6	30%	2.08	5.2	5.5	34%	1.04	3.12	Averages=>		5.7	5.8	32%	1.10					
PGI427	1	4.7	5.3	32%	2.54	1.4	2.8	33%	1.1	3.6											
	2	6.0	6.4	33%	2.40	3.5	5.2	34%	1.1	3.5											
	3	6.9	6.7	24%	2.10	7.3	7.8	28%	1.0	3.1											
	4	8.2	8.0	27%	2.21	6.5	6.5	36%	1.2	3.4											
	5	10.1	10.3	30%	1.32	12.0	9.7	48%	0.1	1.4											
Averages=>		7.2	7.3	29%	2.12	6.1	6.4	36%	0.89	3.00											

Table CA-12. 2011 Buchanan Site Clipping Results

Grass Production							Alfalfa - 1 Cutting in 2011						
Variety	Species	Plot	EC 1:1 @ 3"	EC 1:1 @ 6"	DM	Yield Dry T/A	Variety	Plot	EC 1:1 @ 3"	EC 1:1 @ 6"	DM	Yield Dry T/A	
Garrison	Creeping Foxtail	1	2	2.75	66%	3.27	Travois	1	3.0	3.0	19%	1.87	
		2	5	4.96	67%	2.83		2	4.3	4.1	25%	2.00	
		3	5	5.40	65%	2.75		3	3.2	3.9	24%	1.98	
		4	5	3.05	51%	2.45		4	6.1	5.5	26%	1.88	
		5	4	3.18	51%	2.01		5	6.4	5.3	25%	1.64	
Averages=>			4.2	3.9	60%	2.66	Averages=>			4.6	4.3	24%	1.87
Lincoln	Smooth Bromegrass	1	4	4.08	59%	3.07	DS9412	1	2.2	2.4	23%	2.21	
		2	4	4.32	63%	2.87		2	3.5	3.3	23%	1.80	
		3	5	5.86	59%	2.74		3	3.1	3.6	25%	2.02	
		4	3	2.62	60%	2.23		4	5.7	5.3	26%	1.77	
		5	4	3.06	100%	0.12		5	6.7	5.8	26%	1.34	
Averages=>			3.9	4.0	68%	2.20	Averages=>			4.2	4.1	25%	1.83
Fleet	Meadow Bromegrass	1	2	3.06	57%	2.42	DS876	1	2.5	2.7	22%	2.12	
		2	4	3.92	56%	2.30		2	4.5	4.9	24%	1.83	
		3	6	5.24	88%	0.10		3	5.7	5.0	25%	1.90	
		4	5	3.64	83%	0.17		4	6.1	5.9	31%	1.92	
		5	5	3.35	98%	0.10		5	6.8	6.6	27%	1.32	
Averages=>			4.1	3.8	76%	1.02	Averages=>			5.1	5.0	26%	1.82
Mandan	Canada Wildrye	1	3	2.82	53%	2.29	HybriForce-420/Wet	1	2.3	2.6	22%	1.70	
		2	3	3.65	57%	3.63		2	3.5	3.2	24%	2.11	
		3	4	3.45	53%	3.48		3	5.6	4.6	25%	1.96	
		4	5	5.88	70%	0.20		4	5.6	7.0	27%	1.73	
		5	5	4.10	79%	0.17		5	7.3	6.5	22%	0.81	
Averages=>			4.0	4.0	62%	1.96	Averages=>			4.9	4.8	24%	1.66
Shoshone	Manystem Wildrye	1	2	3.24	57%	2.63	Bullseye	1	2.3	2.5	23%	2.10	
		2	3	5.90	53%	3.45		2	3.5	3.0	25%	1.92	
		3	4	4.62	59%	2.65		3	4.6	3.9	25%	1.99	
		4	3	3.09	58%	2.96		4	5.3	5.5	25%	2.23	
		5	10	8.24	51%	2.77		5	5.5	4.7	23%	0.89	
Averages=>			4.6	5.0	56%	2.89	Averages=>			4.2	3.9	24%	1.83
Alkar	Tall Wheatgrass	1	1	0.90	42%	4.12	Rugged	1	2.2	2.4	21%	1.83	
		2	3	2.54	49%	3.14		2	3.1	3.0	23%	2.22	
		3	4	3.21	58%	2.95		3	4.6	4.2	25%	1.92	
		4	5	3.60	42%	2.79		4	4.8	4.5	22%	2.24	
		5	9	9.82	43%	2.30		5	6.3	5.8	26%	1.03	
Averages=>			4.2	4.0	47%	3.06	Averages=>			4.2	4.0	23%	1.85
Revenue	Slender Wheatgrass	1	3	3.25	55%	2.76	PGI427	1	2.7	2.7	24%	1.87	
		2	5	4.78	59%	3.47		2	4.4	3.3	25%	1.88	
		3	3	3.47	63%	2.90		3	4.4	4.3	24%	2.45	
		4	6	5.24	57%	3.57		4	6.6	6.2	25%	1.72	
		5	7	8.38	58%	2.26		5	6.6	4.6	26%	1.11	
Averages=>			4.8	5.0	58%	2.99	Averages=>			4.9	4.2	25%	1.80
Rodan	Western Wheatgrass	1	3	4.56	57%	2.65	TS4002	1	3.0	3.2	23%	2.39	
		2	3	4.54	65%	2.88		2	3.6	3.4	27%	2.11	
		3	3	3.68	60%	2.68		3	3.3	3.5	23%	2.44	
		4	5	5.08	62%	3.46		4	5.6	4.8	23%	1.58	
		5	8	7.30	62%	2.24		5	7.4	7.0	27%	1.26	
Averages=>			4.5	5.0	61%	2.78	Averages=>			4.6	4.4	25%	1.96
NewHy	Green Wheatgrass	1	3	3.20	65%	3.14	CW064027	1	2.3	2.2	23%	2.00	
		2	5	5.04	61%	3.08		2	4.7	3.2	23%	1.66	
		3	3	3.30	60%	2.84		3	3.6	3.8	25%	2.07	
		4	5	4.74	61%	3.27		4	6.3	6.1	25%	0.99	
		5	14	13.72	58%	2.47		5	5.9	5.2	25%	1.86	
Averages=>			5.7	6.0	61%	2.96	Averages=>			4.6	4.1	24%	1.72
AC Saltlander	Green Wheatgrass	1	3	3.61	61%	2.75	CW054038	1	2.3	2.3	24%	2.04	
		2	5	5.08	64%	2.93		2	3.3	2.3	22%	1.99	
		3	5	5.92	57%	3.30		3	3.5	3.3	23%	1.85	
		4	5	5.90	56%	3.60		4	4.3	4.2	25%	1.89	
		5	10	10.92	62%	0.31		5	5.4	4.4	16%	0.55	
Averages=>			5.8	6.3	60%	2.58	Averages=>			3.8	3.3	22%	1.66
Saltlander Forage Grass Mix	50% AC Saltlander gwg 25% Revenue swg 25% Courtenay tff	1	1	1.87	60%	2.84	CW084034	1	2.9	2.7	25%	2.41	
		2	3	5.04	60%	2.97		2	3.0	2.5	25%	1.85	
		3	6	5.32	64%	3.61		3	3.8	3.0	24%	2.08	
		4	7	7.78	56%	3.60		4	5.5	5.6	25%	2.28	
		5	11	11.34	54%	3.50		5	3.5	3.1	14%	0.49	
Averages=>			5.7	6.3	59%	3.30	Averages=>			3.7	3.4	23%	1.82
Alfalfa	O'Connors	1	10.8	2.6	33%	1.40	PGI908S	1	3.1	2.7	22%	1.79	
		2	6.1	5.4	33%	1.76		2	5.0	4.6	23%	1.88	
		3	8.1	5.6	37%	0.49		3	5.5	4.8	26%	1.62	
		4	0.0	6.4	29%	1.10		4	5.6	3.1	25%	1.40	
		5	3.4	8.8	28%	0.76		5	4.5	3.3	23%	0.83	
Averages=>			5.7	5.8	32%	1.10	Averages=>			4.7	3.7	24%	1.50

Table CA-13. Pasta Plant Site Forage Quality - 2012

Variety/ Species	Plot	CP	HDP	AP	NFC	ADF	NDF	CF	TDN EST. %	NE/ LACT/MC AL/LB	NE/ MAINT/M CAL/LB	NE/ GAIN/M CAL/LB	DDM	Ca	P	K	Mg	RFV
Garrison Creeping Foxtail	1	4.22	0.63	3.9	19.61	43.24	64.84	34.59	53.25	0.54	0.49	0.24	55.22	0.41	0.14	1.26	0.12	79.22
	2	1.16	0.56	0.45	23.29	41.99	64.24	33.59	54.68	0.55	0.51	0.26	56.19	0.27	0.08	0.77	0.02	81.38
	3	2.39	0.57	1.85	21.3	41.12	64.99	32.89	55.67	0.57	0.53	0.27	56.87	0.3	0.08	0.75	0.06	81.4
	4	3.87	0.68	3.41	13.52	46.08	71.29	36.86	50.01	0.5	0.44	0.19	53	0.31	0.12	1.26	0.09	69.16
	5	5.88	0.59	5.88	17.3	43.69	65.5	34.96	52.73	0.53	0.48	0.23	54.86	0.31	0.19	1.66	0.12	77.91
Averages=>		3.50	0.61	3.10	19.00	43.22	66.17	34.58	53.27	0.54	0.49	0.24	55.23	0.32	0.12	1.14	0.08	77.81
Lincoln Smooth Bromegrass	1	5.57	0.49	5.57	24.58	37.62	58.53	30.09	59.66	0.61	0.59	0.33	59.6	0.51	0.09	0.77	0.15	94.72
	2	5.14	0.62	4.96	17.66	40.11	65.88	32.09	56.82	0.58	0.55	0.29	57.66	0.27	0.11	0.89	0.11	81.41
	3	4.17	0.55	3.96	20.03	41.53	64.48	33.23	55.2	0.56	0.52	0.27	56.55	0.33	0.11	1.13	0.07	81.58
	4	6.51	0.52	6.51	20.79	38.91	61.38	31.13	58.18	0.59	0.57	0.31	58.59	0.45	0.12	1.02	0.13	88.8
	5	4.69	0.45	4.69	21.17	39.95	62.82	31.96	57	0.58	0.55	0.29	57.78	0.31	0.1	0.84	0.11	85.56
Averages=>		5.22	0.53	5.14	20.85	39.62	62.62	31.70	57.37	0.58	0.56	0.30	58.04	0.37	0.11	0.93	0.11	86.41
Fleet Meadow Bromegrass	1	3.86	0.73	3.31	14.13	43.35	70.69	34.68	53.12	0.54	0.49	0.24	55.13	0.24	0.13	1.2	0.11	72.54
	2	3.96	0.71	3.45	14.53	42.94	70.2	34.35	53.59	0.54	0.5	0.24	55.45	0.33	0.1	1.04	0.11	73.48
	3	2.83	0.73	2.11	14.24	43.58	71.61	34.86	52.86	0.53	0.49	0.23	54.95	0.23	0.08	0.93	0.06	71.38
	4	3.61	0.74	3.01	12.19	44.91	72.88	35.92	51.35	0.52	0.46	0.21	53.92	0.2	0.12	1.02	0.07	68.83
	5	2.21	0.61	1.58	13.71	42.6	72.76	34.08	53.98	0.55	0.5	0.25	55.71	0.19	0.08	0.66	0.07	71.23
Averages=>		3.29	0.70	2.69	13.76	43.48	71.63	34.78	52.98	0.54	0.49	0.23	55.03	0.24	0.10	0.97	0.08	71.49
Mandan Canada Wildrye	1	4.54	0.55	4.39	12.43	44.35	71.71	35.48	51.98	0.52	0.47	0.22	54.35	0.36	0.12	0.93	0.15	70.5
	2	4.87	0.44	4.87	17.81	40.46	66	32.37	56.42	0.57	0.54	0.29	57.38	0.37	0.1	0.81	0.14	80.88
	3	4.28	0.52	4.14	18.05	41.4	66.35	33.12	55.35	0.56	0.52	0.27	56.65	0.38	0.09	0.8	0.13	79.43
	4	5.24	0.52	5.24	14.19	43.23	69.25	34.59	53.26	0.54	0.49	0.24	55.22	0.3	0.13	0.91	0.14	74.17
	5	6.26	0.53	6.26	15.01	41.66	67.41	33.33	55.05	0.56	0.52	0.27	56.45	0.39	0.16	1.15	0.17	77.89
Averages=>		5.04	0.51	4.98	15.50	42.22	68.14	33.78	54.41	0.55	0.51	0.26	56.01	0.36	0.12	0.92	0.15	76.57
Shoshone Manystem Wildrye	1	4.99	0.71	4.64	15.13	42.03	68.57	33.63	54.62	0.55	0.51	0.26	56.16	0.35	0.15	1.53	0.1	76.18
	2	6.53	0.77	6.35	9.5	45.16	72.64	36.13	51.06	0.51	0.46	0.21	53.72	0.27	0.2	1.98	0.13	68.79
	3	10.97	0.74	10.97	9.27	40.46	68.44	32.37	56.42	0.57	0.54	0.29	57.38	0.44	0.22	1.95	0.21	77.99
	4	4.85	0.72	4.48	12.88	43.78	70.95	35.03	52.63	0.53	0.48	0.23	54.79	0.26	0.14	1.29	0.09	71.84
	5	6.34	0.73	6.18	11.64	43.5	70.71	34.8	52.95	0.54	0.49	0.24	55.02	0.35	0.19	1.67	0.14	72.38
Averages=>		6.74	0.73	6.52	11.68	42.99	70.26	34.39	53.54	0.54	0.50	0.25	55.41	0.33	0.18	1.68	0.13	73.44
Alkar Tall Wheatgrass	1	6.2	0.56	6.2	8.34	46.01	74.14	36.8	50.1	0.5	0.44	0.19	53.06	0.21	0.18	1.45	0.13	66.58
	2	3.97	0.54	3.75	10.83	46.59	73.88	37.27	49.42	0.5	0.43	0.18	52.6	0.13	0.14	1.24	0.09	66.23
	3	5.45	0.57	5.41	10.8	44.78	72.43	35.83	51.49	0.52	0.46	0.21	54.01	0.21	0.16	1.32	0.11	69.37
	4	5.37	0.62	5.24	8.21	46.88	75.1	37.5	49.1	0.49	0.43	0.18	52.38	0.16	0.16	1.37	0.1	64.89
	5	4.81	0.61	4.6	7.31	48.13	76.55	38.5	47.67	0.48	0.4	0.16	51.41	0.14	0.16	1.34	0.11	62.47
Averages=>		5.16	0.58	5.04	9.10	46.48	74.42	37.18	49.56	0.50	0.43	0.18	52.69	0.17	0.16	1.34	0.11	65.91
Revenue Slender Wheatgrass	1	5.27	0.66	5.05	13.04	41.34	70.37	33.07	55.42	0.56	0.53	0.27	56.7	0.39	0.11	0.86	0.12	74.95
	2	5.41	0.67	5.21	11.52	42.39	71.76	33.91	54.22	0.55	0.51	0.25	55.88	0.35	0.12	0.88	0.12	72.44
	3	6.83	0.64	6.83	10.24	42.17	71.61	33.73	54.47	0.55	0.51	0.26	56.05	0.29	0.14	0.99	0.14	72.82
	4	6.31	0.62	6.31	13.47	40.52	68.9	32.41	56.35	0.57	0.54	0.28	57.34	0.38	0.12	0.97	0.13	77.41
	5	6.57	0.57	6.57	15.01	39.46	67.1	31.97	57.55	0.59	0.56	0.3	58.16	0.31	0.13	0.87	0.13	80.63
Averages=>		6.08	0.63	5.99	12.66	41.18	69.95	32.54	55.60	0.56	0.53	0.27	56.83	0.34	0.12	0.91	0.13	75.65
Rodan Western Wheatgrass	1	4.54	0.45	4.54	21.63	38.12	62.51	30.5	59.09	0.6	0.58	0.32	59.2	0.43	0.09	0.67	0.12	88.1
	2	7.22	0.54	7.22	16.9	37.59	64.55	30.07	59.69	0.61	0.59	0.33	59.62	0.46	0.13	0.84	0.17	85.91
	3	11.58	0.56	11.58	13.45	37.77	63.66	30.21	59.49	0.61	0.59	0.33	59.48	0.49	0.2	1.28	0.24	86.92
	4	6.14	0.52	6.14	18.35	37.63	64.18	30.1	59.65	0.61	0.59	0.33	59.59	0.37	0.11	0.72	0.12	86.36
	5	7.07	0.47	7.07	19.54	36.75	62.07	29.4	60.65	0.62	0.61	0.34	60.27	0.47	0.16	1.04	0.17	90.33
Averages=>		7.31	0.51	7.31	17.97	37.57	63.39	30.06	59.71	0.61	0.59	0.33	59.63	0.44	0.14	0.91	0.16	87.52
NewHy Hybrid Wheatgrass	1	3.79	0.45	3.67	24.37	37.35	60.52	29.88	59.97	0.61	0.59	0.33	59.8	0.37	0.09	0.69	0.11	91.92
	2	4.63	0.55	4.49	22.13	38.8	61.92	31.04	58.31	0.59	0.57	0.31	58.68	0.42	0.12	0.94	0.1	88.15
	3	5.76	0.54	5.76	19.08	39.49	63.83	31.59	57.53	0.59	0.56	0.3	58.14	0.33	0.14	1.03	0.14	84.73
	4	3.75	0.53	3.5	22.96	39.75	61.97	31.8	57.23	0.58	0.55	0.3	57.94	0.44	0.1	0.92	0.11	86.97
	5	4.06	0.49	3.92	23.37	38.16	61.26	30.53	59.04	0.6	0.58	0.32	59.17	0.42	0.1	0.83	0.11	89.86
Averages=>		4.40	0.51	4.27	22.38	38.71	61.90	30.97	58.42	0.59	0.57	0.31	58.75	0.40	0.11	0.88	0.11	88.33
AC Saltlander Green Wheatgrass	1	4.41	0.51	4.3	23.21	38.42	61.06	30.73	58.75	0.6	0.58	0.32	58.97	0.45	0.11	0.87	0.1	89.84
	2	4.5	0.5	4.42	22.45	38.38	61.74	30.71	58.79	0.6	0.58	0.32	59	0.39	0.11	0.89	0.11	88.9
	3	4.81	0.42	4.81	22.64	37.9	61.23	30.32	59.33	0.61	0.59	0.33	59.37	0.36	0.11	0.91	0.12	90.2
	4	5.71	0.52	5.71	22.32	36.33	60.66	29.07	61.13	0.63	0.61	0.35	60.6	0.4	0.11	0.84	0.13	92.93
	5	4.53	0.5	4.45	23.91	36.8	60.24	29.44	60.59	0.62	0.6	0.34	60.23	0.47	0.11	0.81	0.13	93.01
Averages=>		4.79	0.49	<														

Table CA-14. Buchanan Site Forage Quality – 2012

Variety/ Species	Plot	CP	HDP	AP	NFC	ADF	NDF	CF	TDN EST.,%	NE/ LACT, MCAL /LB	NE/ MAINT, MCAL /LB	NE/ GAIN, MCAL /LB	DDM	Ca	P	K	Mg	RFV	
Garrison Creeping Foxtail	1	3.82	0.55	3.55	27.17	40.04	57.69	32.03	56.90	0.58	0.55	0.29	57.71	0.61	0.12	1.03	0.09	93.06	
	2	3.51	0.51	3.26	24.45	40.86	60.72	32.69	55.97	0.57	0.53	0.28	57.07	0.45	0.12	1.03	0.06	87.43	
	3	3.98	0.48	3.86	30.05	37.04	54.65	29.63	60.32	0.62	0.60	0.34	60.05	0.66	0.12	0.91	0.09	102.21	
	4	3.21	0.53	2.87	25.41	39.42	60.07	31.54	57.60	0.59	0.56	0.30	58.19	0.42	0.10	0.96	0.07	90.12	
	5	4.25	0.50	4.14	23.27	41.08	61.15	32.87	55.71	0.57	0.53	0.27	56.90	0.46	0.10	0.83	0.08	86.55	
Averages=>		3.75	0.51	3.54	26.07	39.69	58.86	31.75	57.30	0.59	0.55	0.30	57.98	0.52	0.11	0.95	0.08	91.87	
Lincoln Smooth Bromegrass	1	4.99	0.53	4.93	25.23	39.69	58.47	31.76	57.29	0.58	0.55	0.30	57.98	0.63	0.08	0.87	0.14	92.24	
	2	4.38	0.47	4.34	26.86	37.48	57.43	29.98	59.82	0.61	0.59	0.33	59.71	0.56	0.06	0.59	0.10	96.71	
	3	3.91	0.46	3.80	29.71	36.38	55.06	29.10	61.08	0.63	0.61	0.35	60.56	0.68	0.03	0.45	0.14	102.32	
	4	6.51	0.52	6.51	20.79	38.91	61.38	31.13	58.18	0.59	0.57	0.31	58.59	0.45	0.12	1.02	0.13	88.80	
	5	4.16	0.48	4.05	23.02	42.33	61.50	33.86	54.29	0.55	0.51	0.25	55.93	0.38	0.10	0.82	0.11	84.59	
Averages=>		4.79	0.49	4.73	25.12	38.96	58.77	31.17	58.13	0.59	0.57	0.31	58.55	0.54	0.08	0.75	0.12	92.93	
Fleet Meadow Bromegrass	1	5.17	0.64	4.96	21.29	42.29	62.22	33.83	54.33	0.55	0.51	0.26	55.95	0.62	0.14	1.28	0.12	83.65	
	2	5.46	0.68	5.25	22.10	41.53	61.12	33.22	55.20	0.56	0.52	0.27	56.55	0.73	0.12	1.16	0.17	86.06	
	3																		
	4	3.75	0.66	3.30	16.48	41.75	68.45	33.40	54.94	0.56	0.52	0.26	56.37	0.35	0.07	0.56	0.11	76.61	
	5	2.97	0.54	2.59	20.89	41.03	64.82	32.82	55.77	0.57	0.53	0.28	56.94	0.41	0.07	0.66	0.11	81.71	
Averages=>		4.34	0.63	4.03	20.19	41.65	64.15	33.32	55.06	0.56	0.52	0.27	56.45	0.53	0.10	0.92	0.13	82.01	
Mandan Canada Wildrye	1	4.54	0.41	4.54	22.54	38.42	61.60	30.73	58.75	0.60	0.58	0.32	58.97	0.54	0.08	0.67	0.16	89.06	
	2	4.28	0.46	4.23	18.54	41.67	65.86	33.33	55.04	0.56	0.52	0.27	56.44	0.45	0.08	0.68	0.15	79.72	
	3	4.28	0.52	4.14	18.05	41.40	66.35	33.12	55.35	0.56	0.52	0.27	56.65	0.38	0.09	0.80	0.13	79.43	
	4	5.70	0.41	5.70	22.22	39.14	60.76	31.31	57.93	0.59	0.56	0.31	58.41	0.54	0.10	0.86	0.18	89.43	
	5	3.92	0.31	3.92	27.55	37.85	57.21	30.28	59.39	0.61	0.59	0.33	59.41	0.53	0.07	0.62	0.14	96.60	
Averages=>		4.54	0.42	4.51	21.78	39.70	62.36	31.75	57.29	0.58	0.55	0.30	57.98	0.49	0.08	0.73	0.15	86.85	
Shoshone Manystem Wildrye	1	5.17	0.71	4.86	15.10	44.31	68.41	35.45	52.03	0.52	0.47	0.22	54.38	0.41	0.14	1.44	0.09	73.95	
	2	9.45	0.82	9.45	10.11	46.16	69.12	36.93	49.92	0.50	0.44	0.19	52.94	0.45	0.20	1.78	0.13	71.25	
	3	4.40	0.71	3.97	17.30	44.08	66.98	35.27	52.29	0.53	0.48	0.23	54.56	0.48	0.11	1.26	0.08	75.77	
	4	4.84	0.67	4.54	15.21	43.89	68.64	35.11	52.51	0.53	0.48	0.23	54.71	0.34	0.14	1.40	0.08	74.15	
	5	8.24	0.67	8.24	13.75	40.88	66.69	32.71	55.94	0.57	0.53	0.28	57.05	0.41	0.18	1.64	0.16	79.58	
Averages=>		6.42	0.72	6.21	14.29	43.86	67.97	35.09	52.54	0.53	0.48	0.23	54.73	0.42	0.15	1.50	0.11	74.94	
Alkar Tall Wheatgrass	1	4.81	0.56	4.68	8.67	48.91	75.20	39.13	46.78	0.47	0.39	0.14	50.80	0.17	0.17	1.53	0.11	62.84	
	2	3.70	0.52	3.47	13.88	45.68	71.10	36.54	50.47	0.51	0.45	0.20	53.32	0.26	0.10	0.96	0.11	69.75	
	3	3.26	0.49	3.00	15.76	45.60	69.66	36.48	50.56	0.51	0.45	0.20	53.38	0.24	0.10	0.92	0.08	71.29	
	4	3.93	0.51	3.74	11.39	49.09	73.36	39.27	46.57	0.46	0.38	0.14	50.66	0.21	0.14	1.39	0.10	64.24	
	5	10.99	0.39	10.99	11.93	40.35	65.76	32.28	56.55	0.58	0.54	0.29	57.47	0.33	0.22	1.59	0.16	81.30	
Averages=>		5.34	0.49	5.18	12.33	45.93	71.02	36.74	50.19	0.51	0.44	0.19	53.13	0.24	0.15	1.28	0.11	69.88	
Revenue Slender Wheatgrass	1	4.18	0.58	3.91	17.74	40.62	66.76	32.50	56.24	0.57	0.54	0.28	57.26	0.42	0.09	0.61	0.11	79.78	
	2	7.31	0.57	7.31	13.23	40.61	68.14	32.49	56.25	0.57	0.54	0.28	57.26	0.38	0.11	0.67	0.14	78.18	
	3	3.61	0.66	3.14	18.29	40.95	66.78	32.76	55.86	0.57	0.53	0.28	57.00	0.48	0.05	0.46	0.09	79.40	
	4	6.76	0.62	6.76	13.24	41.47	68.68	33.17	55.27	0.56	0.52	0.27	56.60	0.36	0.14	0.96	0.15	76.66	
	5	10.54	0.57	10.54	11.93	39.23	66.21	31.38	57.82	0.59	0.56	0.30	58.34	0.48	0.16	1.08	0.22	81.97	
Averages=>		6.48	0.60	6.33	14.89	40.58	67.31	32.46	56.29	0.57	0.54	0.28	57.29	0.42	0.11	0.76	0.14	79.20	
Rodan Western Wheatgrass	1	5.40	0.49	5.40	20.68	39.28	62.60	31.42	57.77	0.59	0.56	0.30	58.30	0.49	0.12	0.78	0.14	86.63	
	2	4.39	0.58	4.16	22.20	39.50	62.09	31.60	57.51	0.59	0.56	0.30	58.13	0.45	0.09	0.46	0.10	87.09	
	3	4.65	0.36	4.65	23.22	37.70	60.81	30.16	59.56	0.61	0.59	0.33	59.53	0.48	0.08	0.63	0.13	91.06	
	4	8.62	0.61	8.62	16.25	39.23	63.82	31.38	57.83	0.59	0.56	0.30	58.34	0.46	0.13	0.79	0.13	85.05	
	5	10.93	0.57	10.93	12.88	40.05	64.87	32.04	56.89	0.58	0.55	0.29	57.70	0.50	0.19	1.29	0.23	82.74	
Averages=>		6.80	0.52	6.75	19.05	39.15	62.84	31.32	57.91	0.59	0.56	0.30	58.40	0.48	0.12	0.79	0.15	86.51	
NewHy Hybrid Wheatgrass	1	3.35	0.43	3.19	27.10	38.93	58.23	31.14	58.17	0.59	0.57	0.31	58.58	0.51	0.07	0.73	0.10	93.57	
	2	3.74	0.52	3.50	24.02	39.49	60.92	31.59	57.53	0.59	0.56	0.30	58.14	0.50	0.08	0.63	0.11	88.77	
	3	3.33	0.43	3.16	27.32	38.18	58.03	30.54	59.02	0.60	0.58	0.32	59.16	0.51	0.06	0.58	0.10	94.83	
	4	3.73	0.48	3.56	22.37	38.82	62.58	31.06	58.29	0.59	0.57	0.31	58.66	0.36	0.08	0.72	0.09	87.19	
	5	9.24	0.52	9.24	18.65	37.39	60.80	29.91	59.92	0.61	0.59	0.33	59.77	0.53	0.16	1.10	0.24	91.46	
Averages=>		4.68	0.48	4.53	23.89	38.56	60.11	30.85	58.59	0.60	0.57	0.31	58.86	0.48	0.09	0.75	0.13	91.16	
AC Saltlander Green Wheatgrass	1	3.14	0.49	2.86	25.58	37.31	59.96	29.85	60.01	0.61	0.60	0.34	59.83	0.42	0.09	0.67	0.08	92.82	
	2	3.93	0.46	3.83	26.44	37.07	58.30	29.66	60.29	0.62	0.60	0.34	60.02	0.57	0.08	0.72	0.11	95.76	
	3	8.77	0.52	8.77	17.49	38.77	62.42	31.02	58.35	0.60	0.57	0.31	58.70	0.41	0.15	1.22	0.16	87.48	
	4	8.03	0.51	8.03	18.01	40.72	62.64	32.58	56.12	0.57	0.54	0.28	57.18	0.45	0.15	1.22	0.17	84.91	
	5	9.09	0.56	9.09	19.72	36.91	59.87	29.53	60.47	0.62	0.60	0.34	60.15	0.52	0.17	1.00	0.24	93.45	
Averages=>		6.59	0.51	6.52	21.45	38.16	60.64												

ACTIVE STUDIES: TECHNICAL REPORT 2011-2012

Study Number	NDPMC-T-1201
Title	Rhizome Growth Comparison of AC Saltlander, NewHy, Quackgrass, and Smooth Brome
Objective	Compare rhizome spread, seed production and overall growth of AC Saltlander and NewHy to quackgrass and smooth brome
Duration	2012-2014
Cooperators	USDA, NRCS Bismarck Plant Materials Center
Location	Bismarck, ND PMC
-----Soils	Mandan silt loam
-----MLRA	53B
-----Precip.	Ave. (1981-2012): 17.8 inches Ave. (2012): 14.9 inches

Background information: Palatable forage species are needed for planting on saline sites. Available species for planting these sites are limited. Recent releases, AC Saltlander and NewHy are adapted to saline conditions. Seed is available in the seed market. Both releases are quackgrass hybrids. Quackgrass is a noxious weed in many states. It is strongly rhizomatous and can become invasive. Though the literature indicates that these releases have a more bunch-type growth than quackgrass, questions have been raised about their invasiveness in the Dakota's and Minnesota. The effects that rhizome spread and seed production may have on land adjoining the area where AC Saltlander and NewHy may be planted is of concern. Data from this study will be considered when determining the inclusion or exclusion of these releases in the ND NRCS Field Office Technical Guide. In this study, the AC Saltlander and NewHy are compared with quackgrass and smooth brome. Smooth brome is also a very rhizomatous species that can become invasive.

AC Saltlander was developed by researchers in Utah and Saskatchewan. Its parental origin is Turkey. It is a natural hybrid between the Eurasian bluebunch wheatgrass complex (*Pseudoroegneria strigosa*, *P. geniculata*, *P. stيفolia*) and quackgrass (*Elymus repens*). Its common name is green wheatgrass and the species name of the cross is *Elymus hoffmannii*. The physical characteristics of the seed are similar to quackgrass but it is genetically different from quackgrass. Plants from the original collection were selected for bunchy growth, vegetative vigor, leafiness, seed set, uniform plant color and freedom from pests. It was further selected for resistance to root zone salinity, winter hardiness, and other desirable traits. It is documented to have a limited degree of rhizomatous growth.

NewHy was developed by USDA forage breeders in Utah. It was synthetically developed by crossing quackgrass with the native North American bluebunch wheatgrass (*Pseudoroegneria spicata*). Field trials in Utah, Idaho, and Montana suggest it is suitable for sites with moderate to severe salinity which receive at least 13 inches of moisture.

Methods and Materials

Seed Source	AC Saltlander, NewHy, Rebound smooth brome, quackgrass
Propagation	Seed planted to containers in the greenhouse, then seedlings planted to field bed
-----Greenhouse	Planting Date: March 2012 Pots: Ray Leach cone-tainers TM (2" x 7") Soil: Miracle Grow Potting Mix
-----Field	Planting Date: May 21, 2012 Planting Method: Hand-dibble bar Conditions: soil firm and slightly moist, black and free of growing weeds
Assembly	SEE FIGURE RH-1 for Map
-----Location	Bismarck Plant Materials Center, Panel A USDA Hardiness Zone (2012): 4a
-----Design	Randomized complete block Reps: 4 Each of the four species were planted in blocks of 10 plants for each replication
Data Collection	Dates: 7/20/2012, 9/12/2012
-----Parameters	2012: height, width, vigor, no. of culms, rhizome spread, plant size
-----Data	SEE TABLE RH-1 of DATA
Field Maintenance	Weed control
-----2012	weeding, spot sprayed glyphosate on strawberry clover and Canada thistle

Results and Discussion

2012: Plant growth was good for all species. The dry, hot conditions for 2012 probably slowed growth on all plants in the study. Only a few plants died from transplanting. As first year transplants, plants were becoming established and plant growth was not consistent. Quackgrass height, overall, was shorter compared to the other entries. Rhizome growth appeared to start later in the season. Visual observations of the plots after the September data collection showed tremendous rhizome spread for some plants. This growth will be captured with 2013 measurements. Strawberry clover was previously planted in the field used for this study. It was controlled in 2012, but may become a problem if it is not closely managed.

2013 Plans: Broadleaf weed control, data collection for rhizome spread and seed production

Figure RH-1. Plot layout of rhizome growth comparison of ACSaltlander, NewHy, quackgrass, and smooth brome

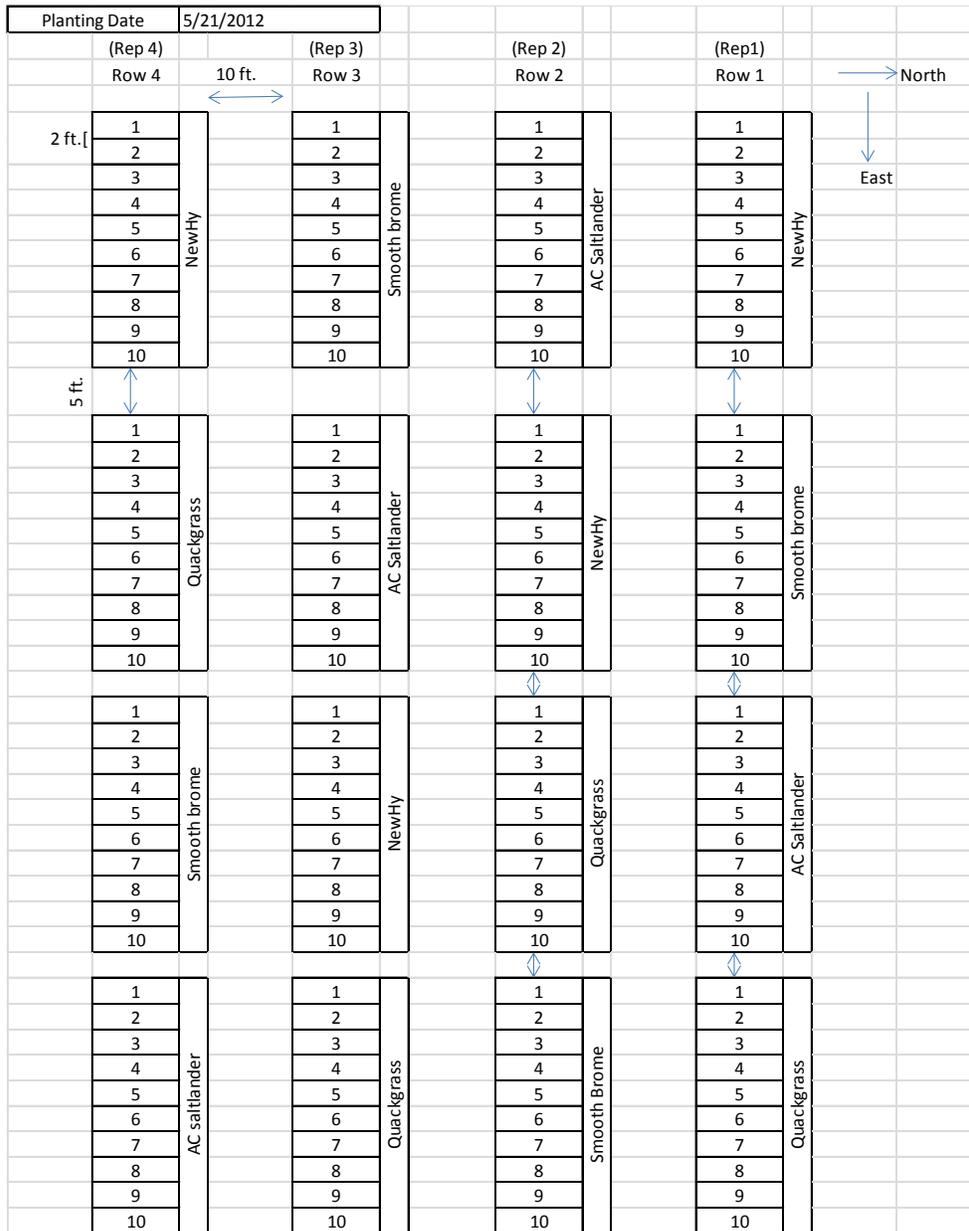


Table RH-1. 2012 evaluation data - rhizome growth comparison of ACSaltlander, NewHy, quackgrass, and smooth brome

Ratings

spread:	1=excellent, 9=poor
vigor:	1=excellent, 9=poor
culm:	1=many, 9=none
size:	1=large, 9=small

Species	Rep	Plant	Date	inches Height	rating Spread	inches Width	rating Vigor	rating Culms	rating Size	no. seedheads	no. new shoots
Acsalt	1	1	9/12/2012	15		28	5	8			
Acsalt	1	2	9/12/2012	17		25	6	9			
Acsalt	1	3	9/12/2012	13		28	5	9			
Acsalt	1	4	9/12/2012	17		35	2	9			
Acsalt	1	5	9/12/2012	16		36	4	5			
Acsalt	1	6	9/12/2012	12		21	7	8			
Acsalt	1	7	9/12/2012	19		29	5	9			
Acsalt	1	8	9/12/2012	15		30	5	9			
Acsalt	1	9	9/12/2012	8		42	5	3			
Acsalt	1	10	9/12/2012	11		22	5	9			
Acsalt	2	1	9/12/2012	dead							
Acsalt	2	2	9/12/2012	13		33	4	7			
Acsalt	2	3	9/12/2012	10		18	7	9			
Acsalt	2	4	9/12/2012	14		55	4	4			
Acsalt	2	5	9/12/2012	17		28	4	9			
Acsalt	2	6	9/12/2012	18		49	2	4			
Acsalt	2	7	9/12/2012	18		33	3	4			
Acsalt	2	8	9/12/2012	20		21	5	8			
Acsalt	2	9	9/12/2012	13		39	4	9			
Acsalt	2	10	9/12/2012	21		33	3	9			
Acsalt	3	1	9/12/2012	27		52	1	3			
Acsalt	3	2	9/12/2012	38		18	3	9			
Acsalt	3	3	9/12/2012	36		21	3	8			
Acsalt	3	4	9/12/2012	24		46	3	4			
Acsalt	3	5	9/12/2012	17		30	3	9			
Acsalt	3	6	9/12/2012	18		40	2	3			
Acsalt	3	7	9/12/2012	23		26	3	8			
Acsalt	3	8	9/12/2012	6		36	4	5			
Acsalt	3	9	9/12/2012	6		30	5	7			
Acsalt	3	10	9/12/2012	15		24	4	9			
Acsalt	4	1	9/12/2012	10		25	3	9			
Acsalt	4	2	9/12/2012	13		33	3	4			
Acsalt	4	3	9/12/2012	12		30	5	9			
Acsalt	4	4	9/12/2012	15		34	2	3			
Acsalt	4	5	9/12/2012	7		32	5	7			
Acsalt	4	6	9/12/2012	10		27	4	3			
Acsalt	4	7	9/12/2012	14		31	3	6			
Acsalt	4	8	9/12/2012	8		21	4	7			
Acsalt	4	9	9/12/2012	15		28	3	7			
Acsalt	4	10	9/12/2012	17		22	4	5			
Acsalt	1	1	7/20/2012		3				5	5	7
Acsalt	1	2	7/20/2012		9				4	0	1

Species	Rep	Plant	Date	inches Height	rating Spread	inches Width	rating Vigor	rating Culms	rating Size	no. seedheads	no. new shoots
Acsalt	1	3	7/20/2012		5				3	4	2
Acsalt	1	4	7/20/2012		3				2	0	15
Acsalt	1	5	7/20/2012		2				3	29	31
Acsalt	1	6	7/20/2012		9				6	1	0
Acsalt	1	7	7/20/2012		9				4	0	0
Acsalt	1	8	7/20/2012		4				3	0	7
Acsalt	1	9	7/20/2012		4				3	17	3
Acsalt	1	10	7/20/2012		9				4	0	0
Acsalt	2	1	7/20/2012		9				6	0	
Acsalt	2	2	7/20/2012		6				4	3	
Acsalt	2	3	7/20/2012		5				5	0	
Acsalt	2	4	7/20/2012		5				3	12	
Acsalt	2	5	7/20/2012		9				2	0	
Acsalt	2	6	7/20/2012		1				3	11	
Acsalt	2	7	7/20/2012		1				4	10	
Acsalt	2	8	7/20/2012		4				3	1	
Acsalt	2	9	7/20/2012		3				2	0	
Acsalt	2	10	7/20/2012		2				1	0	
Acsalt	3	1	7/20/2012		2				2	12	
Acsalt	3	2	7/20/2012		2				3	2	
Acsalt	3	3	7/20/2012		3				2	1	
Acsalt	3	4	7/20/2012		3				2	14	
Acsalt	3	5	7/20/2012		3				2	0	
Acsalt	3	6	7/20/2012		3				3	26	
Acsalt	3	7	7/20/2012		3				3	0	
Acsalt	3	8	7/20/2012		3				4	c	
Acsalt	3	9	7/20/2012		3				5	2	
Acsalt	3	10	7/20/2012		5				5	0	
Acsalt	4	1	7/20/2012		4				4	0	
Acsalt	4	2	7/20/2012		4				4	7	
Acsalt	4	3	7/20/2012		4				4	0	
Acsalt	4	4	7/20/2012		5				3	34	
Acsalt	4	5	7/20/2012		9				4	1	
Acsalt	4	6	7/20/2012		9				4	16	
Acsalt	4	7	7/20/2012		5				3	5	
Acsalt	4	8	7/20/2012		7				2	31	
Acsalt	4	9	7/20/2012		9				2	14	
Acsalt	4	10	7/20/2012		5				2	23	
brome	1	1	9/12/2012	21		33	5	5			
brome	1	2	9/12/2012	20		30	5	7			
brome	1	3	9/12/2012	25		18	4	4			
brome	1	4	9/12/2012	27		33	3	5			
brome	1	5	9/12/2012	28		30	5	7			
brome	1	6	9/12/2012	23		33	4	5			
brome	1	7	9/12/2012	21		28	5	5			
brome	1	8	9/12/2012	18		30	6	5			
brome	1	9	9/12/2012	21		30	5	5			
brome	1	10	9/12/2012	22		32	5	5			

Species	Rep	Plant	Date	inches Height	rating Spread	inches Width	rating Vigor	rating Culms	rating Size	no. seedheads	no. new shoots
brome	2	1	9/12/2012	25		26	3	3			
brome	2	2	9/12/2012	23		23	5	5			
brome	2	3	9/12/2012	14		28	5	9			
brome	2	4	9/12/2012	21		30	4	5			
brome	2	5	9/12/2012	16		25	5	5			
brome	2	6	9/12/2012	18		22	4	5			
brome	2	7	9/12/2012	19		19	5	9			
brome	2	8	9/12/2012	13		23	6	5			
brome	2	9	9/12/2012	22		21	4	4			
brome	2	10	9/12/2012	25		22	6	9			
brome	3	1	9/12/2012	18		32	6	6			
brome	3	2	9/12/2012	18		32	5	9			
brome	3	3	9/12/2012	15		21	6	3			
brome	3	4	9/12/2012	19		23	4	9			
brome	3	5	9/12/2012	22		25	3	5			
brome	3	6	9/12/2012	12		28	4	9			
brome	3	7	9/12/2012	10		24	6	5			
brome	3	8	9/12/2012	30		36	3	9			
brome	3	9	9/12/2012	25		30	5	8			
brome	3	10	9/12/2012	28		36	2	3			
brome	4	1	9/12/2012	18		32	4	6			
brome	4	2	9/12/2012	27		16	3	9			
brome	4	3	9/12/2012	22		17	3	9			
brome	4	4	9/12/2012	20		15	4	7			
brome	4	5	9/12/2012	32		24	3	5			
brome	4	6	9/12/2012	21		31	3	6			
brome	4	7	9/12/2012	28		23	3	4			
brome	4	8	9/12/2012	20		23	5	7			
brome	4	9	9/12/2012	24		26	3	9			
brome	4	10	9/12/2012	17		15	5	8			
brome	1	1	7/20/2012		3				3	8	11
brome	1	2	7/20/2012		3				3	3	19
brome	1	3	7/20/2012		3				1	16	20
brome	1	4	7/20/2012		3				1	6	17
brome	1	5	7/20/2012		4				3	0	24
brome	1	6	7/20/2012		2				2	2	45
brome	1	7	7/20/2012		3				3	7	27
brome	1	8	7/20/2012		3				2	12	26
brome	1	9	7/20/2012		3				4	3	15
brome	1	10	7/20/2012		5				3	13	9
brome	2	1	7/20/2012		2				2	15	
brome	2	2	7/20/2012		4				4	12	
brome	2	3	7/20/2012		4				4	0	
brome	2	4	7/20/2012		4				3	12	
brome	2	5	7/20/2012		3				4	9	
brome	2	6	7/20/2012		3				4	6	
brome	2	7	7/20/2012		3				5	0	
brome	2	8	7/20/2012		5				5	5	
brome	2	9	7/20/2012		3				4	3	

Species	Rep	Plant	Date	inches Height	rating Spread	inches Width	rating Vigor	rating Culms	rating Size	no. seedheads	no. new shoots
brome	2	10	7/20/2012		3				4	0	
brome	3	1	7/20/2012		4				6	0	
brome	3	2	7/20/2012		4				4	0	
brome	3	3	7/20/2012		4				4	3	
brome	3	4	7/20/2012		5				5	0	
brome	3	5	7/20/2012		5				4	3	
brome	3	6	7/20/2012		6				4	c	
brome	3	7	7/20/2012		4				5	6	
brome	3	8	7/20/2012		4				3	1	
brome	3	9	7/20/2012		4				4	3	
brome	3	10	7/20/2012		2				1	12	
brome	4	1	7/20/2012		7				4	2	
brome	4	2	7/20/2012		5				4	1	
brome	4	3	7/20/2012		5				4	0	
brome	4	4	7/20/2012		6				4	7	
brome	4	5	7/20/2012		4				4	11	
brome	4	6	7/20/2012		4				3	15	
brome	4	7	7/20/2012		4				3	15	
brome	4	8	7/20/2012		5				5	4	
brome	4	9	7/20/2012		5				3	0	
brome	4	10	7/20/2012		5				4	1	
NewHy	1	1	9/12/2012	28		42	3	6			
NewHy	1	2	9/12/2012	16		28	4	4			
NewHy	1	3	9/12/2012	20		29	4	7			
NewHy	1	4	9/12/2012	24		34	3	6			
NewHy	1	5	9/12/2012	13		32	4	7			
NewHy	1	6	9/12/2012	14		33	5	6			
NewHy	1	7	9/12/2012	15		28	4	8			
NewHy	1	8	9/12/2012	25		42	2	5			
NewHy	1	9	9/12/2012	16		43	4	5			
NewHy	1	10	9/12/2012	20		39	4	9			
NewHy	2	1	9/12/2012	23		45	1	2			
NewHy	2	2	9/12/2012	20		36	3	4			
NewHy	2	3	9/12/2012	15		26	5	9			
NewHy	2	4	9/12/2012	21		34	3	3			
NewHy	2	5	9/12/2012	20		36	3	3			
NewHy	2	6	9/12/2012	20		33	4	2			
NewHy	2	7	9/12/2012	19		36	4	9			
NewHy	2	8	9/12/2012	22		30	3	7			
NewHy	2	9	9/12/2012	11		36	5	3			
NewHy	2	10	9/12/2012	13		22	6	9			
NewHy	3	1	9/12/2012	dead							
NewHy	3	2	9/12/2012	18		31	3	3			
NewHy	3	3	9/12/2012	15		30	3	9			
NewHy	3	4	9/12/2012	16		31	5	9			
NewHy	3	5	9/12/2012	31		17	3	7			
NewHy	3	6	9/12/2012	18		23	5	4			
NewHy	3	7	9/12/2012	19		33	3	5			

Species	Rep	Plant	Date	inches Height	rating Spread	inches Width	rating Vigor	rating Culms	rating Size	no. seedheads	no. new shoots
NewHy	3	8	9/12/2012	13		36	3	6			
NewHy	3	9	9/12/2012	19		29	3	3			
NewHy	3	10	9/12/2012	28		27	5	5			
NewHy	4	1	9/12/2012	12		29	4	6			
NewHy	4	2	9/12/2012	14		28	5	9			
NewHy	4	3	9/12/2012	12		36	5	4			
NewHy	4	4	9/12/2012	16		20	5	7			
NewHy	4	5	9/12/2012	20		34	4	7			
NewHy	4	6	9/12/2012	14		32	4	9			
NewHy	4	7	9/12/2012	20		30	4	4			
NewHy	4	8	9/12/2012	16		30	4	7			
NewHy	4	9	9/12/2012	14		36	4	9			
NewHy	4	10	9/12/2012	16		32	4	8			
NewHy	1	1	7/20/2012		9				3	4	2
NewHy	1	2	7/20/2012		5				2	27	2
NewHy	1	3	7/20/2012		3				3	10	5
NewHy	1	4	7/20/2012		3				1	6	9
NewHy	1	5	7/20/2012		4				2	2	7
NewHy	1	6	7/20/2012		6				2	5	4
NewHy	1	7	7/20/2012		6				3	21	6
NewHy	1	8	7/20/2012		3				2	42	3
NewHy	1	9	7/20/2012		5				1	20	0
NewHy	1	10	7/20/2012		3				3	1	2
NewHy	2	1	7/20/2012		2				2	38	
NewHy	2	2	7/20/2012		4				1	16	
NewHy	2	3	7/20/2012		9				5	0	
NewHy	2	4	7/20/2012		3				2	44	
NewHy	2	5	7/20/2012		3				1	26	
NewHy	2	6	7/20/2012		4				2	38	
NewHy	2	7	7/20/2012		5				3	0	
NewHy	2	8	7/20/2012		4				4	7	
NewHy	2	9	7/20/2012		3				2	16	
NewHy	2	10	7/20/2012		3				5	0	
NewHy	3	1	7/20/2012		9				5	0	
NewHy	3	2	7/20/2012		5				4	28	
NewHy	3	3	7/20/2012		4				3	0	
NewHy	3	4	7/20/2012		9				4	0	
NewHy	3	5	7/20/2012		3				3	3	
NewHy	3	6	7/20/2012		9				3	16	
NewHy	3	7	7/20/2012		9				3	14	
NewHy	3	8	7/20/2012		5				3	3	
NewHy	3	9	7/20/2012		3				3	27	
NewHy	3	10	7/20/2012		4				3	12	
NewHy	4	1	7/20/2012		4				4	23	
NewHy	4	2	7/20/2012		3				3	0	
NewHy	4	3	7/20/2012		9				1	29	
NewHy	4	4	7/20/2012		4				4	3	
NewHy	4	5	7/20/2012		4				3	3	
NewHy	4	6	7/20/2012		3				3	0	

Species	Rep	Plant	Date	inches Height	rating Spread	inches Width	rating Vigor	rating Culms	rating Size	no. seedheads	no. new shoots
NewHy	4	7	7/20/2012		4				2	20	
NewHy	4	8	7/20/2012		4				2	3	
NewHy	4	9	7/20/2012		2				2	0	
NewHy	4	10	7/20/2012		2				2	1	
quack	1	1	9/12/2012	5		36	6	9			
quack	1	2	9/12/2012	6		33	6	8			
quack	1	3	9/12/2012	18		28	5	9			
quack	1	4	9/12/2012	6		20	7	9			
quack	1	5	9/12/2012	4		20	7	9			
quack	1	6	9/12/2012	5		30	6	9			
quack	1	7	9/12/2012	11		29	5	5			
quack	1	8	9/12/2012	10		30	6	8			
quack	1	9	9/12/2012	5		21	7	9			
quack	1	10	9/12/2012	4		23	7	9			
quack	2	1	9/12/2012	5		36	4	7			
quack	2	2	9/12/2012	8		36	5	9			
quack	2	3	9/12/2012	18		30	4	8			
quack	2	4	9/12/2012	4		19	8	9			
quack	2	5	9/12/2012	9		46	4	5			
quack	2	6	9/12/2012	36		6	5	8			
quack	2	7	9/12/2012	16		36	4	5			
quack	2	8	9/12/2012	5		30	7	8			
quack	2	9	9/12/2012	5		30	7	9			
quack	2	10	9/12/2012	7		30	6	9			
quack	3	1	9/12/2012	5		36	5	9			
quack	3	2	9/12/2012	16		23	5	4			
quack	3	3	9/12/2012	15		32	4	7			
quack	3	4	9/12/2012	dead							
quack	3	5	9/12/2012	7		40	5	7			
quack	3	6	9/12/2012	8		27	5	9			
quack	3	7	9/12/2012	7		29	5	7			
quack	3	8	9/12/2012	5		26	6	7			
quack	3	9	9/12/2012	20		28	4	9			
quack	3	10	9/12/2012	12		50	3	6			
quack	4	1	9/12/2012	8		28	4	7			
quack	4	2	9/12/2012	16		16	4	2			
quack	4	3	9/12/2012	4		25	5	9			
quack	4	4	9/12/2012	12		10	5	2			
quack	4	5	9/12/2012	10		24	5	5			
quack	4	6	9/12/2012	5		24	6	5			
quack	4	7	9/12/2012	10		32	4	4			
quack	4	8	9/12/2012	5		31	6	9			
quack	4	9	9/12/2012	15		33	4	9			
quack	4	10	9/12/2012	14		32	4	7			
quack	1	1	7/20/2012		3				5	0	6
quack	1	2	7/20/2012		9				6	0	0
quack	1	3	7/20/2012		4				7	0	11
quack	1	4	7/20/2012		9				5	0	0

Species	Rep	Plant	Date	inches Height	rating Spread	inches Width	rating Vigor	rating Culms	rating Size	no. seedheads	no. new shoots
quack	1	5	7/20/2012		9				5	0	1
quack	1	6	7/20/2012		3				5	7	0
quack	1	7	7/20/2012		2				5	0	7
quack	1	8	7/20/2012		3				5	0	4
quack	1	9	7/20/2012		9				5	0	0
quack	1	10	7/20/2012		9				6	0	0
quack	2	1	7/20/2012		7				4	5	
quack	2	2	7/20/2012		2				4	0	
quack	2	3	7/20/2012		4				3	2	
quack	2	4	7/20/2012		9				4	0	
quack	2	5	7/20/2012		4				4	10	
quack	2	6	7/20/2012		4				5	1	
quack	2	7	7/20/2012		3				1	2	
quack	2	8	7/20/2012		9				5	3	
quack	2	9	7/20/2012		3				5	0	
quack	2	10	7/20/2012		9				4	0	
quack	3	1	7/20/2012		4				4	0	
quack	3	2	7/20/2012		4				6	6	
quack	3	3	7/20/2012		7				5	4	
quack	3	4	7/20/2012		dead						
quack	3	5	7/20/2012		9				4	7	
quack	3	6	7/20/2012		9				5	0	
quack	3	7	7/20/2012		3				5	3	
quack	3	8	7/20/2012		5				5	9	
quack	3	9	7/20/2012		4				3	0	
quack	3	10	7/20/2012		3				4	9	
quack	4	1	7/20/2012		9				5	3	
quack	4	2	7/20/2012		9				2	contaminant	
quack	4	3	7/20/2012		9				7	0	
quack	4	4	7/20/2012		7				4	23	
quack	4	5	7/20/2012		7				4	11	
quack	4	6	7/20/2012		9				6	7	
quack	4	7	7/20/2012		9				4	12	
quack	4	8	7/20/2012		5				6	0	
quack	4	9	7/20/2012		5				4	0	
quack	4	10	7/20/2012		9				2	5	

ACTIVE STUDIES: TECHNICAL REPORT 2011-2012

Study Number	NDPMC-T-1202
Title	Cupplant Evaluation, northern origin (<i>Silphium perfoliatum</i>)
Objective	Evaluate performance of northern origin cupplant and evaluate species attributes for bioengineering, riparian, pollinators, and others. Release and Technology is goal.
Duration	2012-2020
Cooperators	USDA, NRCS Bismarck Plant Materials Center
Location	Bismarck, ND PMC
-----Soils	Mandan silt loam
-----MLRA	53B
----- Precip.	Ave (1981-2010): 17.8 inches Ave (2012): 14.9 inches

Background information: Cupplant is a tall, warm-season species native to the tall grass prairie. It has a taproot and underground rhizomes. Its cup forming leaves are important for pollinator species. It prefers moist sites. Native northern sources of the species are not readily found. The PMC is evaluating a northern origin source (or sources if more are found).

Methods and Materials

The planting in 2012 consisted of one seed origin.

Seed Source	Accession: 9094351
----- Coll. Date	September 19, 2011
-----Collector	Jeff Printz
-----Location	T135N R56W sec 30 Ransom County, ND approx. 4 miles NW of Lisbon off of Valley Road USDA Hardiness Zone (2012): 4a
Propagation	Seed planted to conetainers in the greenhouse, then seedlings planted to field bed
-----Greenhouse	Planting Date: February 2012 Pots: Ray Leach cone-tainers™ (2 “x 7”) Soil: Miracle Grow Potting Mix
-----Field	Planting Method: Holes dug with shovel and garden trowel Planting Conditions: Soil firm and slightly moist, black and free of growing weeds, freshly tilled Planting Date: June 11, 2012
Assembly	NO MAP
-----Location	Bismarck Plant Materials Center, Panel D10 (old deer fence) USDA Hardiness Zone (2012): 4a
-----Design	No. of Rows: 5 Row spacing: 7-10’ Plant Spacing: 2’-3’
Data Collection	None in 2012
-----Parameters	2012: none
-----Data	2012: none
Field Maintenance	Weed control, residue removal
-----2012	Hand weeding, tillage between rows, no residue removal, no herbicide, no irrigation

Results and Discussion

2012: Plants were vigorous and appeared healthy throughout the growing season, even though the summer was hot and dry. Plants had only basal, rosette type growth this first year of growth.

2013 Plans: Weed control as needed for thistle and grassy weeds, data collection related to plant growth, flowering time, and seed production

ACTIVE STUDIES: TECHNICAL REPORT 2011-2012

Study Number	NDPMC-T-1203
Title	Effects of Mixed Species Cover Crops on Soil Health
Objective	Evaluate the effects of different cover crop species mixes, and seeding rates on soil health
Duration	2012-2014+ (extension of study is probable, depending on outcomes)
Cooperators	Plant Materials Program, NRCS National Soil Health Team, ,USDA,NRCS National Soil Survey Center (Lincoln, NE-Kellog Soil Survey Lab),USDA, ARS (Temple, TX)
Location	D-7 Bismarck, ND Plant Materials Center
---Soils	Mandan silt loam, See Figure CC-1 for Soils Mapping Units
---MLRA	53B
---Ave. Precip.	Overall (1981-2012)=17.8 inches 2012 overall= 14.9 inches 2012 cover crop planting to termination=2.08 inches
---Lat./Long.	Latitude=46 ⁰ 46', Longitude=100 ⁰ 45W, Elev.=1647
Other Locations with similar study	Plant Materials Centers in CA, FL, MD, MO,WA

Background information: This is a National Plant Materials project evaluating the effect of different cover crop species and seeding rates on soil health. There are six Plant Materials Centers participating in this study. The commodity crop to be planted by ND and WA PMC is barley. Corn will be planted by all other PMC's. Protocols for designing the experiment and data collection were compiled by Regional Specialists of the Plant Materials Program. This information is filed in the Cover Cops study binder.

Materials and Method

Experimental Design	Randomized complete block Replications: 4
---Plot size	Each plot: 30' x 50' Total plots: 40 See Figure CC-2 for Plot Map
Cover Crop Mixes	1=triticale, red clover 2=triticale, red clover, hairy vetch, radish 3=triticale, red clover, hairy vetch, radish, oats, rapeseed 4=no cover crop (control)
---Seed source	Pulse USA-Bismarck ND
---Seeding rates	20 seeds/ft ² 40 seeds/ft ² 60 seeds/ft ² See Table CC-1 for actual seeding amounts of each species
---Seeding date	August 2, 2012
---Termination	September 21, 2012
Commodity Crop	2012=none
Seeding Method	No till
---2012	Cover Crop=No-Till plot drill (Great Plains) borrowed from ARS , used boxes (not cone) for seeding
Data Parameters	Soils, Vegetative- the portion of the plot sampled was approx. 17'X30'

Data Collection

All plots were divided into three sections for the three years of data collection. This is indicated on the plot map. A different section will be sampled each of the three years. All data, unless indicated otherwise, will be taken from the designated section.

---2012: Dates of sampling generally indicate before cover crop planting , at 30 days from planting, and/or cover crop termination (47 days).

Soils Parameter	Date of Sample	Method	Depth	Samples	Data Table
---classification	7/30/2012	Order 1 Soil Survey, descriptions made, sent to soil survey lab to cross check soil particle size			Figure CC-1

---bulk density	7/30/2012	3" ring (soil quality test kit)	0-3 inches	5 samples/plot	Table CC-2
---temperature	7/30/2012, 9/25/2012	soil thermometer	0-3 inches	5 samples/plot	Table CC-3
---moisture	7/30/2012, 9/25/2012	Hydrosense moisture meter	0-3 inches	5 samples/plot	Table CC-3
---resistance	7/30/2012	penetrometer	6 inches	5 samples/plot	Table CC-3
---biological	7/30/2012, 9/25/2012	Hand trowel, samples dried at Mandan ARS, sent to Dr. Haney (TX) for analysis Oct 2012, kept in cold and dry storage prior to sending	0-6 inches	2/3 quart/plot	Table CC-4
---soil indicators	8/30/2012	Hand trowel samples dried at Mandan ARS, sent to Larry Arnold, Lincoln, NE for analysis	0-2 inches and 2-4 inches	2/3 quart/plot for each depth	Test results are pending

---Soil Notes: Personnel from soils staffs within ND NRCS were leaders in collecting the soils data. Personnel from NRCS Soils staffs included: Susan Liebig, Perry Sullivan, Hal Weiser, Kyle Thomson and Beth Burdoski. PMC staff assisted the soils staff. Along with listed measured soil parameters, some infiltration rates were also measured in a few random plots. A soil survey pit was also dug in the late fall and samples taken down to 100 cm. These samples will get a complete soil characterization by the Soil Survey Laboratory in Lincoln, NE. The pit was dug in the vicinity where the HOBO weather station is scheduled (for 2013) to be placed. It should also be noted that samples for soil indicator measurements were originally taken at 0-6". These were not sent in for analysis, but were archived to use as baseline data, if needed.

Plant Parameter	Date of Sample	Method	Number of Samples	Data Table
---canopy cover	8/31/2012 9/25/2012	Line transect-entire plot (30' X 50' plot size), recorded type of cover every 1 foot of diagonal transect	50 points/plot	Table CC-5
---plant height	8/31/2012 9/25/2012	5 random plant areas(17' X 30' portion of plot)	5 heights/plot	Table CC-5
---yield	9/25/2012	Clipped 50cm x 100cm frame within each plot, 1/4" stubble height, separated components, dried samples at 55° C, weighed parts separately, combined all parts except radish bottom,	1 frame/plot	Table CC-6
---%N	9/25/2012	Combined dry sample of all parts but radish bottom, hammer milled prior to sending for analysis by Dairy One Lab, Ithaca, NY (sent to NPMC to handle)	1 sample/plot (2 if radish present)	Table CC-6
---quality	9/25/2012	Clipped random plots from entire planting and bulked within each species. Oven dried at 50° C. Sent one sample of each specie to Stearns DHIA (MN) for separate species analysis	1 sample/species	Table CC-6

---Plant Notes: Sample drying was done in batches. Radish roots were difficult to dry, so were cut in smaller pieces. All vegetation was left standing on the plots over the winter. Height of plots was taken in inches and converted to cm. The initial hard frost was considered cover crop termination. Plants continued to grow after the initial hard frost. The ND NRCS State agronomist Ted Alme and Dwight Tober (retired PMS) assisted in clipping forage production. Dwight Tober also assisted in canopy cover measurements.

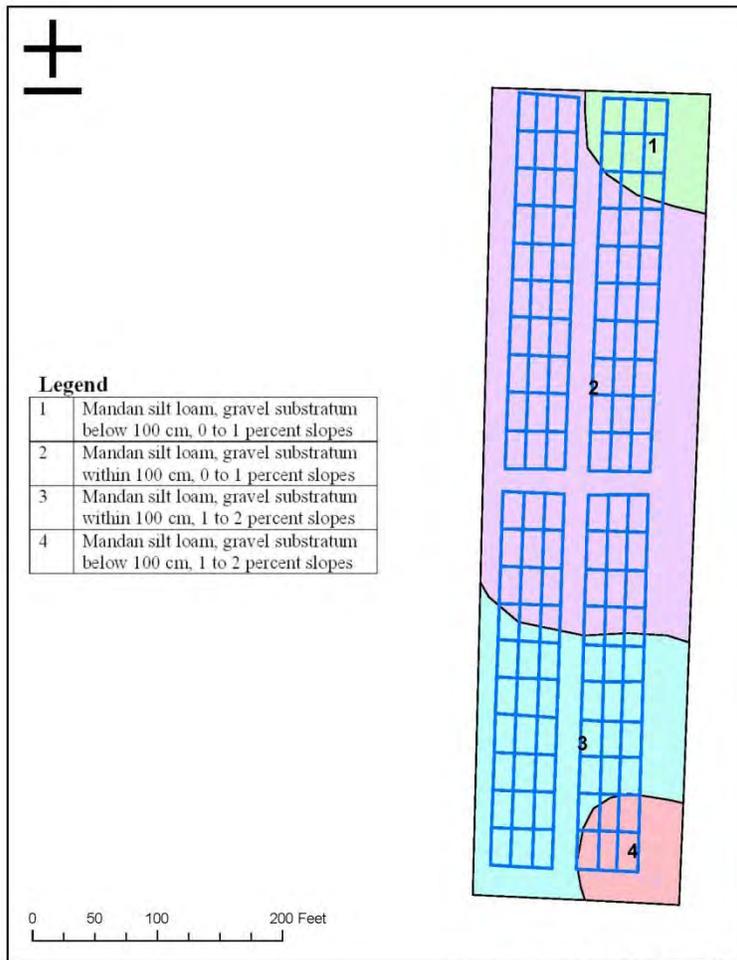
Results and Discussion:

2012: Cover crop growth was good even though planting date was late in the season and precipitation was 20% below normal for the growing season. Hard frosts came late in the fall, which may have allowed for extended growth. The legume component growth was not abundant, as is shown in the yield data. This may be due to the short window of time it had to grow before a frost. Baseline soils data indicated soils in all plots were high in N. This may be due to previous history of composting on the field. Growth of the cover crop in Replication 2 and Replication 4 was stunted as a result of a tree row (green ash) to the east of the field.

Summary of the Cover Crop Measurements (Joel Douglas, Regional Plant Materials Specialist)

Early results from the cover crop measurements at Bismarck found that increasing the seeding rate of 2, 4 and 6 cover crop species/mix from 20, 40 and 60 seed/ft², respectively, increased dry matter yield, N content, N accumulation, and plant height but the increase was not significant. Conversely, increasing the seeding rate increased early canopy cover of cover crop mixes 30 days after planting but the increase in coverage after 60 days was not significant except in the triticale and red clover treatment where % canopy cover provided by the 20 seed/ft² was 74% compared to > 90% provided by 40 and 60 seed/ft². Oil seed radish root production and N content was not significantly influenced by seeding rate. Triticale and mixes containing oil seed radish contributed to the greatest percentage of the total dry matter yield while the least amount was provided by the legumes. Increasing the seeding rate suppressed weed growth in all seed mixes. Statistical analysis (by Joel Douglas, Regional Plant Materials Specialist) can be found in CC-Tables 7 through 18.

Figure CC-1. Cover crop study soil survey (soils mapping unit descriptions follow)



Created by: Bismarck MLRA Soil Survey Office

Soils mapping units

Map unit 1 - Mandan silt loam, gravelly substratum below 100 cm, 0 to 1 percent slopes

Taxonomic Class: Coarse-silty, mixed, superactive, calcareous, frigid Pachic Haplustolls

The Mandan series consists of very deep, well drained soils on terraces in alluvial plains. Permeability is moderately high in the surface layer and moderately low to moderately high in the substratum. These soils formed in loess over gravel.

Landform: Terrace
Landscape: Alluvial Plain
Parent Material: Loess over Gravel
Slope Range: 0 to 1%
Depth to Gravel: > 100 cm
Salt or Sodium Affected: Not Affected
Drainage Class: Well
Water Table: > 6 feet
Ponding: None

Typical Profile

Ap ---0 to 28 cm; silt loam
Bw ---28 to 57 cm; silt loam
Bk ---57 to 86 cm; silt loam
Bck ---86 to 110 cm; very fine sandy loam
2C --- 110 to 120 cm; very gravelly sand

Typical Range

Mollic, Ap: 46-65 cm
Depth to Carbonates: 24-30 cm
Depth to Gravel: 102-132 cm

Major uses: Cropland

Map unit 2 - Mandan silt loam, gravelly substratum within 100 cm, 0 to 1 percent slopes

Taxonomic Class: Coarse-silty, mixed, superactive, calcareous, frigid Pachic Haplustolls

The Mandan series consists of very deep, well drained soils on terraces in alluvial plains. Permeability is moderately high in the surface layer and moderately low to moderately high in the substratum. These soils formed in loess over gravel.

Landform: Terrace
Landscape: Alluvial Plain
Parent Material: Loess over Gravel
Slope Range: 0 to 1%
Depth to Gravel: 85-100 cm
Salt or Sodium Affected: Not Affected
Drainage Class: Well
Water Table: > 6 feet
Ponding: None

Typical Profile

Ap ---0 to 25 cm; silt loam
Bw ---25 to 59 cm; silt loam
Bk ---59 to 91 cm; very fine sandy loam
2C ---91-120 cm; very gravelly sand

Typical Range

Mollic, Ap: 25-59 cm
Depth to Carbonates: 25-91 cm
Depth to Gravel: 91-120 cm

Major uses: Cropland

Map unit 3 - Mandan silt loam, gravelly substratum within 100 cm, 1 to 2 percent slopes

Taxonomic Class: Coarse-silty, mixed, superactive, calcareous, frigid Pachic Haplustolls

The Mandan series consists of very deep, well drained soils on terraces in alluvial plains. Permeability is moderately high in the surface layer and moderately low to moderately high in the substratum. These soils formed in loess over gravel.

Landform: Terrace
Landscape: Alluvial Plain
Parent Material: Loess over Gravel
Slope Range: 1 to 2%
Depth to Gravel: 85 cm
Salt or Sodium Affected: Not Affected
Drainage Class: Well
Water Table: > 6 feet
Ponding: None

Typical Profile

Ap ---0 to 33 cm; silt loam
Bw ---33 to 63 cm; silt loam
Bk ---63 to 85 cm; silt loam
2C ---85-120 cm; very gravelly sand

Typical Range

Mollic, Ap: 53-63 cm
Depth to Carbonates: 20-33 cm
Depth to Gravel: 85-87 cm

Major uses: Cropland

Map unit 4 - Mandan silt loam, gravelly substratum below 100 cm, 1 to 2 percent slopes

Taxonomic Class: Coarse-silty, mixed, superactive, calcareous, frigid Pachic Haplustolls

The Mandan series consists of very deep, well drained soils on terraces in alluvial plains. Permeability is moderately high in the surface layer and moderately low to moderately high in the substratum. These soils formed in loess over gravel.

Landform: Terrace
Landscape: Alluvial Plain
Parent Material: Loess over Gravel
Slope Range: 1 to 2%
Depth to Gravel: 122cm +
Salt or Sodium Affected: Not Affected
Drainage Class: Well
Water Table: > 6 feet
Ponding: None

Typical Profile

Ap ---0 to 24 cm; silt loam
Bw ---24 to 62 cm; silt loam
Bk ---62 to 122 cm; silt loam
2C ---122cm; very gravelly loamy sand

Typical Range

Mollic, Ap: 9-15"
Depth to Carbonates: 24-62 cm
Depth to Gravel: 122 cm

Major uses: Cropland

Figure CC-2. Plot map

A	101	01
YR3	YR2	YR1
B	102	02
YR2	YR1	YR3
C	103	03
YR1	YR3	YR2
D	104	04
YR1	YR2	YR3
E	105	05
YR1	YR3	YR2
F	106	06
YR1	YR2	YR3
G	107	07
YR2	YR3	YR1
H	108	08
YR1	YR3	YR2
I	109	09
YR2	YR3	YR1
J	110	10
YR3	YR1	YR2

F	201	11
YR1	YR2	YR3
G	202	12
YR1	YR2	YR3
C	203	13
YR3	YR1	YR2
D	204	14
YR3	YR2	YR1
A	205	15
YR2	YR3	YR1
I	206	16
YR3	YR1	YR2
J	207	17
YR1	YR2	YR3
H	208	18
YR3	YR2	YR1
E	209	19
YR2	YR1	YR3
B	210	20
YR2	YR3	YR1

- A** Triticale, Red clover/20 seed ft²
- B** Triticale, Red clover/40 seed ft²
- C** Triticale, Red clover/60 seed ft²
- D** Triticale, Red clover, Hairy Vetch, Radish/20 seed ft²
- E** Triticale, Red clover, Hairy Vetch, Radish/40 seed ft²
- F** Triticale, Red clover, Hairy Vetch, Radish/60 seed ft²
- G** Triticale, Red clover, Hairy Vetch, Radish, Oats, Rapeseed/20 seed ft²
- H** Triticale, Red clover, Hairy Vetch, Radish, Oats, Rapeseed/40 seed ft²
- I** Triticale, Red clover, Hairy Vetch, Radish, Oats, Rapeseed/60 seed ft²
- J** Control – No Cover Crop

C	301	21
YR2	YR1	YR3
G	302	22
YR1	YR2	YR3
I	303	23
YR3	YR2	YR1
B	304	24
YR1	YR2	YR3
J	305	25
YR3	YR1	YR2
F	306	26
YR2	YR3	YR1
A	307	27
YR3	YR2	YR1
D	308	28
YR3	YR1	YR2
H	309	29
YR1	YR2	YR3
E	310	30
YR1	YR2	YR3

F	401	31
YR2	YR3	YR1
C	402	32
YR3	YR1	YR2
H	403	33
YR1	YR2	YR3
D	404	34
YR3	YR2	YR1
A	405	35
YR1	YR2	YR3
J	406	36
YR2	YR1	YR3
E	407	37
YR1	YR2	YR3
I	408	38
YR2	YR3	YR1
B	409	39
YR1	YR2	YR3
G	410	40
YR3	YR1	YR2

Table CC-1. Seeding rates for cover crop species

Mixes	Species	Seeds/lb	Seeding Rate per Plot in seeds/ft2	% of the Mix	PLS Lbs. per Acre
2 Species Mix	triticale	12000	20	50	36.3
	red clover	260000		50	1.68
	triticale	12000	40	50	72.60
	red clover	260000		50	3.35
	triticale	12000	60	50	108.90
	red clover	260000		50	5.03
4 Species Mix	triticale	12000	20	45	32.67
	red clover	260000		22.5	0.75
	hairy vetch	21000		22.5	9.33
	radish	45000		10	1.94
	triticale	12000	40	45	65.34
	red clover	260000		22.5	1.51
	hairy vetch	21000		22.5	18.67
	radish	45000		10	3.87
	triticale	12000	60	45	98.01
	red clover	260000		22.5	2.26
	hairy vetch	21000		22.5	28.00
	radish	45000		10	5.81
6 Species Mix	triticale	12000	20	22.5	16.34
	red clover	260000		22.5	0.75
	hairy vetch	21000		22.5	9.33
	radish	45000		5	0.97
	oats	14000		22.5	14.00
	Rape	156960		5	0.28
	triticale	12000	40	22.5	32.67
	red clover	260000		22.5	1.51
	hairy vetch	21000		22.5	18.67
	radish	45000		5	1.94
	oats	14000		22.5	28.00
	Rape	156960		5	0.56
	triticale	12000	60	22.5	49.01
	red clover	260000		22.5	2.26
	hairy vetch	21000		22.5	28.00
	radish	45000		5	2.90
	oats	14000		22.5	42.00
	Rape	156960		5	0.83

Table CC-2. 2012 bulk density(core method) at 0-3 inches

Date	Plot ID	Average soil bulk density (g/cm ³)
7/30/2012	101	1.30
7/30/2012	102	1.28
7/30/2012	103	1.23
7/30/2012	104	1.23
7/30/2012	105	1.28
7/30/2012	106	1.24
7/30/2012	107	1.23
7/30/2012	108	1.22
7/30/2012	109	1.24
7/30/2012	110	1.14
7/30/2012	201	1.23
7/30/2012	202	1.19
7/30/2012	203	1.23
7/30/2012	204	1.25
7/30/2012	205	1.22
7/30/2012	206	1.21
7/30/2012	207	1.20
7/30/2012	208	1.09
7/30/2012	209	1.17
7/30/2012	210	1.16
7/30/2012	301	0.97
7/30/2012	302	1.17
7/30/2012	303	1.02
7/30/2012	304	1.10
7/30/2012	305	1.00
7/30/2012	306	1.06
7/30/2012	307	1.04
7/30/2012	308	1.01
7/30/2012	309	1.05
7/30/2012	310	1.11
7/30/2012	401	1.07
7/30/2012	402	1.05
7/30/2012	403	1.16
7/30/2012	404	1.09
7/30/2012	405	1.18
7/30/2012	406	1.19
7/30/2012	407	1.19
7/30/2012	408	1.13
7/30/2012	409	1.19
7/30/2012	410	1.04

Table CC-3. 2012 Soil moisture, temperature, resistance

Date	Plot ID	0''- 3'' Soil Moisture % or μ s	3'' Soil Temperature °F	0''- 6'' Soil Resistance psi
7/30/2012	101	13.4	90.54	288
9/25/2012	101	12.4	52.64	
7/30/2012	102	15	91.04	284
9/25/2012	102	13.2	52.92	
7/30/2012	103	14	92.52	300
9/25/2012	103	15.6	50.98	
7/30/2012	104	15.2	92.34	296
9/25/2012	104	16.8	51.86	
7/30/2012	105	15.6	90.78	290
9/25/2012	105	14.8	51.22	
7/30/2012	106	15.4	90.98	258
9/25/2012	106	14.4	50.9	
7/30/2012	107	14.8	91.58	260
9/25/2012	107	16.2	52.46	
7/30/2012	108	12.4	92.04	280
9/25/2012	108	14.2	52.76	
7/30/2012	109	14.6	91.58	280
9/25/2012	109	14	52.74	
7/30/2012	110	13.2	92.26	273
9/25/2012	110	18.8	53.92	
7/30/2012	201	16	76.78	224
9/25/2012	201	14	53.7	
7/30/2012	202	17.8	76.78	260
9/25/2012	202	12.4	53.9	
7/30/2012	203	16.2	77.14	258
9/25/2012	203	13	54.58	
7/30/2012	204	13.4	76.62	284
9/25/2012	204	12.8	54.16	
7/30/2012	205	12.2	76.16	300
9/25/2012	205	12.8	53.64	
7/30/2012	206	13.2	76.52	252
9/25/2012	206	15.2	52.4	
7/30/2012	207	16.6	77.56	260
9/25/2012	207	24	54.88	
7/30/2012	208	14.8	76.82	300
9/25/2012	208	15.4	52.12	
7/30/2012	209	17.4	76.88	246
9/25/2012	209	16	51.92	
7/30/2012	210	15.6	77.3	286
9/25/2012	210	15.6	52.92	

Date	Plot ID	0''- 3'' Soil Moisture % or μ s	3'' Soil Temperature °F	0''- 6'' Soil Resistance psi
7/30/2012	301	15.2	80.62	290
9/25/2012	301	14	51.62	
7/30/2012	302	19.2	80.5	270
9/25/2012	302	17.4	52.52	
7/30/2012	303	16.8	81.32	290
9/25/2012	303	16.6	51.04	
7/30/2012	304	16	80.34	260
9/25/2012	304	16.2	52.82	
7/30/2012	305	15.2	80.48	258
9/25/2012	305	22.2	54.52	
7/30/2012	306	15.8	80.8	270
9/25/2012	306	15.2	53.48	
7/30/2012	307	17.6	81.38	278
9/25/2012	307	18.4	54.88	
7/30/2012	308	15.8	81.7	266
9/25/2012	308	15.4	53.76	
7/30/2012	309	16.6	83.16	258
9/25/2012	309	12.8	54.24	
7/30/2012	310	15.8	82.52	254
9/25/2012	310	13.4	54.92	
7/30/2012	401	14.2	79.86	268
9/25/2012	401	16	52.32	
7/30/2012	402	15.8	79.94	265
9/25/2012	402	15.6	51.08	
7/30/2012	403	18.6	80.08	292
9/25/2012	403	14.8	51.72	
7/30/2012	404	15.4	79.48	277
9/25/2012	404	16.2	53.12	
7/30/2012	405	17.2	79.98	292
9/25/2012	405	16	54.1	
7/30/2012	406	16.6	79.94	273
9/25/2012	406	17.8	54.94	
7/30/2012	407	15.6	79.86	289
9/25/2012	407	14.6	54.92	
7/30/2012	408	14.6	79.52	283
9/25/2012	408	13.8	54.22	
7/30/2012	409	15	79.34	255
9/25/2012	409	15.6	53.3	
7/30/2012	410	17.2	79.28	252
9/25/2012	410	16.8	52.58	

Notes

7/30/2012 date is before cover crop planting and 9/25/2012 date is at cover crop termination

Soil Resistance psi of 300 -may be greater than 300 as this is as far as penetrometer went in soil

Plot 2010 and Plot 410 had poor stands, short and dry on east 1/2 due to tree row

Table CC-4. Biological analysis

Cover Crop	Plot	Date	N (lbs/ac)	P205 (lbs/ac)	K20 lbs/ac	Total N lbs/ac	Inorganic N (lbs/ac)	Organic N (lbs/ac)	Solvita 1-day CO2-C (ppm)	Organic C (ppm)	Organic N (ppm)	Organic C:N	Total P (lbs/ac)	Inorganic P (lbs/ac)	Organic P (lbs/ac)	Soil Health
Triticale, Red clover- 20 seeds/ft2	101	7/30/2012	188	400	632	247	187	61	24	284	30	9	550	396	154	8
	101	9/25/2012	145	460	673	217	147	70	22	312	35	9	623	456	167	9
	205	7/30/2012	244	385	788	300	234	65	28	339	33	10	547	381	166	9
	205	9/25/2012	145	473	759	230	125	105	33	375	52	7	593	466	128	14
	307	7/30/2012	428	606	1052	482	408	74	50	387	37	10	821	599	222	12
	307	9/25/2012	335	555	914	468	324	144	29	391	72	5	660	548	112	17
	405	7/30/2012	299	501	884	399	307	93	31	395	46	9	672	495	176	12
	405	9/25/2012	293	519	828	410	276	134	28	388	67	6	607	513	94	15
Triticale, Red clover- 40 seeds/ft2	102	7/30/2012	245	374	758	316	258	58	22	313	29	11	515	372	144	8
	102	9/25/2012	missing data													
	210	7/30/2012	390	474	902	441	362	79	42	373	39	9	660	468	192	12
	210	9/25/2012	205	552	828	293	170	123	37	415	62	7	676	544	132	16
	304	7/30/2012	438	535	1078	515	433	82	39	431	41	11	743	530	213	12
	304	9/25/2012	348	546	957	469	310	159	37	456	79	6	660	537	123	19
	409	7/30/2012	329	558	949	395	301	94	39	394	47	8	736	551	185	13
	409	9/25/2012	294	494	894	377	246	132	33	378	66	6	607	486	121	16
Triticale, Red clover- 60 seeds/ft2	103	7/30/2012	318	393	896	379	308	71	37	355	36	10	545	387	158	11
	103	9/25/2012	156	435	926	236	144	93	31	410	46	9	587	430	157	12
	203	7/30/2012	323	387	822	383	330	53	33	348	27	13	552	384	168	9
	203	9/25/2012	missing data													
	301	7/30/2012	345	554	980	401	315	86	40	394	43	9	764	548	216	13
	301	9/25/2012	206	481	876	314	181	133	33	434	66	7	596	474	121	16
	402	7/30/2012	407	555	923	499	398	101	35	392	51	8	644	548	96	13
	402	9/25/2012	216	524	846	311	193	117	31	369	59	6	637	517	120	14

Cover Crop	Plot	Date	N (lbs/ac)	P205 (lbs/ac)	K2O lbs/ac	Total N lbs/ac	Inorganic N (lbs/ac)	Organic N (lbs/ac)	Solvita 1-day CO2-C (ppm)	Organic C (ppm)	Organic N (ppm)	Organic C:N	Total P (lbs/ac)	Inorganic P (lbs/ac)	Organic P (lbs/ac)	Soil Health
Triticale, Red clover, Hairy vetch, Radish-20 seeds/ft2	104	7/30/2012	288	354	811	400	325	76	39	347	38	9	481	348	133	12
	104	9/25/2012	241	416	918	336	241	95	33	395	48	8	566	410	156	13
	204	7/30/2012	273	370	772	316	249	67	39	340	34	10	513	364	148	11
	204	9/25/2012	120	401	701	210	110	100	27	384	50	8	504	395	108	12
	308	7/30/2012	478	592	1095	512	365	147	45	424	74	6	828	581	247	19
	308	9/25/2012	352	570	1040	469	320	149	29	451	75	6	685	564	122	17
	404	7/30/2012	343	506	920	425	333	93	45	392	46	8	674	498	176	14
	404	9/25/2012	328	609	931	414	278	135	39	392	68	6	725	600	124	17
Triticale, Red clover, Hairy vetch, Radish-40 seeds/ft2	105	7/30/2012	320	463	918	413	323	90	29	387	45	9	637	458	179	12
	105	9/25/2012	232	426	931	317	228	88	28	392	44	9	589	421	168	11
	209	7/30/2012	374	503	963	457	382	74	16	380	37	10	695	501	194	9
	209	9/25/2012	245	502	846	355	226	128	33	406	64	6	628	494	134	16
	310	7/30/2012	439	537	1132	508	419	89	37	419	44	9	729	531	198	13
	310	9/25/2012	322	519	972	434	289	145	31	405	73	6	616	511	105	17
	407	7/30/2012	352	489	945	431	345	86	28	366	43	8	660	484	176	11
	407	9/25/2012	210	453	846	323	203	120	26	377	60	6	566	447	118	14
Triticale, Red clover, Hairy vetch, Radish-60 seeds/ft2	106	7/30/2012	missing data													
	106	9/25/2012	187	446	883	264	162	102	35	397	51	8	600	440	161	14
	201	7/30/2012	379	456	969	418	358	60	39	347	30	12	660	452	209	10
	201	9/25/2012	262	602	920	372	245	127	35	399	63	6	757	594	163	16
	306	7/30/2012	399	590	1019	455	376	80	44	392	40	10	787	583	203	12
	306	9/25/2012	364	587	959	490	328	162	35	427	81	5	722	579	143	19
	401	7/30/2012	334	514	924	443	390	53	42	402	27	15	692	512	181	10
	401	9/25/2012	271	572	914	351	217	134	47	423	67	6	681	562	119	18

Cover Crop	Plot	Date	N (lbs/ac)	P205 (lbs/ac)	K2O lbs/ac	Total N lbs/ac	Inorganic N (lbs/ac)	Organic N (lbs/ac)	Solvita 1-day CO2-C (ppm)	Organic C (ppm)	Organic N (ppm)	Organic C:N	Total P (lbs/ac)	Inorganic P (lbs/ac)	Organic P (lbs/ac)	Soil Health
Triticale, Red clover, Hairy vetch, Radish, Oats, Rapeseed- 20 seeds/ft2	107	7/30/2012	388	550	967	459	366	93	39	374	47	8	736	542	194	13
	107	9/25/2012	325	563	943	412	303	110	33	403	55	7	736	557	179	14
	202	7/30/2012	347	439	924	402	351	51	44	331	26	13	616	435	181	9
	202	9/25/2012	242	575	849	332	218	114	35	402	57	7	681	567	113	15
	302	7/30/2012	404	490	1017	469	401	68	44	402	34	12	679	485	193	11
	302	9/25/2012	284	474	884	382	251	131	35	387	65	6	573	466	106	16
	410	7/30/2012	405	641	1065	499	390	109	27	422	54	8	853	636	218	13
	410	9/25/2012	418	662	945	512	340	172	80	460	86	5	718	643	75	28
Triticale, Red clover, Hairy vetch, Radish, Oats, Rapeseed- 40 seeds/ft2	108	7/30/2012	318	436	896	407	317	90	35	387	45	9	587	430	157	12
	108	9/25/2012	224	520	924	307	205	102	40	406	51	8	681	512	169	14
	208	7/30/2012	368	484	879	384	302	83	35	350	41	8	658	478	180	12
	208	9/25/2012	222	516	844	312	195	116	33	396	58	7	630	509	122	15
	309	7/30/2012	443	527	1101	484	399	84	44	389	42	9	741	520	221	13
	309	9/25/2012	255	449	897	381	246	136	26	411	68	6	552	443	109	15
	403	7/30/2012	359	473	930	433	349	84	39	366	42	9	639	466	174	12
	403	9/25/2012	196	438	738	297	190	107	23	357	53	7	547	433	115	12
Triticale, Red clover, Hairy vetch, Radish, Oats, Rapeseed- 60 seeds/ft2	408	7/30/2012	337	442	911	424	339	85	33	378	43	9	598	437	161	12
	408	9/25/2012	215	427	787	302	190	112	33	379	56	7	520	420	99	14
	109	7/30/2012	366	585	945	447	359	88	37	387	44	9	782	578	204	12
	109	9/25/2012	242	626	927	336	237	99	33	416	49	8	817	620	196	13
	206	7/30/2012	342	434	891	390	318	71	40	362	36	10	603	428	175	11
	206	9/25/2012	150	482	809	249	138	111	29	381	56	7	603	475	127	14
	303	7/30/2012	419	573	1022	467	367	100	47	386	50	8	782	564	218	15
	303	9/25/2012	311	585	911	407	279	128	47	404	64	6	692	574	118	18

Cover Crop	Plot	Date	N (lbs/ac)	P2O5 (lbs/ac)	K2O lbs/ac	Total N lbs/ac	Inorganic N (lbs/ac)	Organic N (lbs/ac)	Solvita 1-day CO2-C (ppm)	Organic C (ppm)	Organic N (ppm)	Organic C:N	Total P (lbs/ac)	Inorganic P (lbs/ac)	Organic P (lbs/ac)	Soil Health
No Cover Crop	110	7/30/2012	334	580	954	427	336	91	37	404	46	9	766	573	192	13
	110	9/25/2012	389	617	1001	485	376	109	39	389	54	7	807	609	198	15
	207	7/30/2012	359	454	902	414	366	48	26	345	24	14	633	453	180	8
	207	9/25/2012	311	539	862	430	295	135	28	369	68	5	642	532	109	16
	305	7/30/2012	440	599	1099	495	398	96	50	406	48	8	833	590	243	15
	305	9/25/2012	421	605	1032	572	386	187	33	439	93	5	725	596	128	21
	406	7/30/2012	367	493	954	463	360	103	33	373	51	7	685	486	199	13
	406	9/25/2012	357	481	872	461	323	138	33	353	69	5	596	472	123	17

Component

N (lbs/ac)	plant available Nitrogen	K2O (lbs/ac)	plant available K ₂ O
P₂O₅ (lbs/ac)	plant available P ₂ O ₅	Total N (lbs/ac)	total water extractable N
Inorganic N (lbs/ac)	soil extracted with water and analyzed for NH ₄ and NO ₃ nitrogen		
Organic N (lbs/ac)	total water extractable N minus the inorganic N		
Solvita 1-day CO₂-C	amount of CO ₂ -C released in 24 hours from soil microbes after soil has been dried and rewetted. This is the measure of microbial activity in the soil and is highly related to the fertility of the soil. The higher the number, the more fertile the soil.		
Organic C	amount of organic C extracted from the soil with water. This pool of carbon is roughly 80 times smaller than the total soil organic C pool (% organic matter) and reflects the energy source that is driving the soil microbes.		
Organic N	amount of water extractable organic N in soil in ppm		
Organic C:N	ratio of organic C to organic N in soil based on a water extraction. This number is used in conjunction with the Solvita CO ₂ -C number to estimate potential N and P release. It is also used in the soil health calculation. This number is very sensitive indicator of the health of the soil and has a significant impact on the activity of the soil microbes. A number below 20 is desirable.		
Total P	amount of P in the soil extracted with H ₃ A and analyzed on ICP expressed as P ₂ O ₅		
Inorganic P	Soil extracted with H ₃ A and analyzed for orthophosphate expressed as P ₂ O ₅		
Organic P	Total P minus inorganic P expressed as P ₂ O ₅		
Soil Health	Calculated as 1-day CO ₂ divided by the organic C:N ratio plus a weighted organic C and organic N addition. It represents the overall health of the soil system. A number below 8 is desirable. Tracking this number helps gauge the effects of management practices over time.		

Table CC-5. Canopy cover and plant height

Cover Crop Mix	Plot ID	Date	Percentage (1.00=100%)													Plot Height (cm)
			Total Cover	Bare Ground	Weed	Planted Grass	Planted Legume	Planted Forb	Total Planted Cover	Rye/ Triticale	Oat	Clover	Vetch	Rape	Radish	
Triticale, Red clover	101	8/31/12	0.64	0.36	0.06	0.56	0.02	0.00	0.58	0.56	0.00	0.02	0.00	0.00	0.00	11.20
	101	9/18/12	0.92	0.08	0.16	0.74	0.00	0.02	0.76	0.74	0.00	0.00	0.00	0.00	0.02	22.90
	205	8/31/12	0.60	0.40	0.34	0.26	0.00	0.00	0.26	0.26	0.00	0.00	0.00	0.00	0.00	14.00
	205	9/18/12	0.88	0.12	0.22	0.66	0.00	0.00	0.66	0.66	0.00	0.00	0.00	0.00	0.00	35.10
	307	8/31/12	0.68	0.32	0.16	0.50	0.00	0.02	0.52	0.50	0.00	0.00	0.00	0.00	0.02	8.10
	307	9/18/12	0.96	0.04	0.22	0.72	0.00	0.02	0.74	0.72	0.00	0.00	0.00	0.00	0.02	22.90
	405	8/31/12	0.66	0.34	0.34	0.30	0.02	0.00	0.32	0.30	0.00	0.00	0.02	0.00	0.00	15.00
20 seeds/ft2	405	9/18/12	0.94	0.06	0.14	0.80	0.00	0.00	0.80	0.80	0.00	0.00	0.00	0.00	0.00	33.00
Triticale, Red clover	102	8/31/12	0.72	0.28	0.14	0.58	0.00	0.00	0.58	0.58	0.00	0.00	0.00	0.00	0.00	14.00
	102	9/18/12	0.98	0.02	0.04	0.92	0.00	0.02	0.94	0.92	0.00	0.00	0.00	0.00	0.02	28.40
	210	8/31/12	0.66	0.34	0.18	0.48	0.00	0.00	0.48	0.48	0.00	0.00	0.00	0.00	0.00	17.50
	210	9/18/12	0.92	0.08	0.10	0.82	0.00	0.00	0.82	0.82	0.00	0.00	0.00	0.00	0.00	34.50
	304	8/31/12	0.54	0.46	0.14	0.40	0.00	0.00	0.40	0.40	0.00	0.00	0.00	0.00	0.00	13.20
	304	9/18/12	1.00	0.00	0.10	0.90	0.00	0.00	0.90	0.90	0.00	0.00	0.00	0.00	0.00	27.40
	409	8/31/12	0.78	0.22	0.08	0.70	0.00	0.00	0.70	0.70	0.00	0.00	0.00	0.00	0.00	17.80
40 seeds/ft2	409	9/18/12	0.96	0.04	0.04	0.92	0.00	0.00	0.92	0.92	0.00	0.00	0.00	0.00	0.00	33.50
Triticale, Red clover	103	8/31/12	0.74	0.26	0.08	0.64	0.02	0.00	0.66	0.64	0.00	0.02	0.00	0.00	0.00	17.30
	103	9/18/12	0.98	0.02	0.06	0.92	0.00	0.00	0.92	0.92	0.00	0.00	0.00	0.00	0.00	29.50
	203	8/31/12	0.76	0.24	0.08	0.68	0.00	0.00	0.68	0.68	0.00	0.00	0.00	0.00	0.00	19.10
	203	9/18/12	0.94	0.06	0.02	0.92	0.00	0.00	0.92	0.92	0.00	0.00	0.00	0.00	0.00	34.30
	301	8/31/12	0.70	0.30	0.12	0.58	0.00	0.00	0.58	0.58	0.00	0.00	0.00	0.00	0.00	17.80
	301	9/18/12	1.00	0.00	0.02	0.98	0.00	0.00	0.98	0.98	0.00	0.00	0.00	0.00	0.00	31.50
	402	8/31/12	0.74	0.26	0.02	0.72	0.00	0.00	0.72	0.72	0.00	0.00	0.00	0.00	0.00	17.30
60 seeds/ft2	402	9/18/12	0.88	0.12	0.00	0.88	0.00	0.00	0.88	0.88	0.00	0.00	0.00	0.00	0.00	33.50
Triticale, Red clover Hairy vetch, Radish	104	8/31/12	0.72	0.28	0.16	0.22	0.08	0.26	0.56	0.22	0.00	0.00	0.08	0.00	0.26	9.70
	104	9/18/12	1.00	0.00	0.02	0.54	0.02	0.42	0.98	0.54	0.00	0.00	0.02	0.00	0.42	26.90
	204	8/31/12	0.78	0.22	0.30	0.26	0.02	0.20	0.48	0.26	0.00	0.00	0.02	0.00	0.20	13.70
	204	9/18/12	0.96	0.04	0.06	0.50	0.02	0.38	0.90	0.50	0.00	0.00	0.02	0.00	0.38	34.50
	308	8/31/12	0.72	0.28	0.14	0.36	0.10	0.12	0.58	0.36	0.00	0.00	0.10	0.00	0.12	10.20
	308	9/18/12	0.98	0.02	0.12	0.48	0.02	0.36	0.86	0.48	0.00	0.00	0.02	0.00	0.36	25.90
	404	8/31/12	0.78	0.22	0.12	0.36	0.06	0.24	0.66	0.36	0.00	0.00	0.06	0.02	0.22	16.50
20 seeds/ft2	404	9/18/12	0.96	0.04	0.04	0.36	0.02	0.54	0.92	0.36	0.00	0.00	0.02	0.00	0.54	36.10
Triticale, Red clover Hairy vetch, Radish	105	8/31/12	0.86	0.14	0.06	0.34	0.08	0.38	0.80	0.34	0.00	0.00	0.08	0.00	0.38	15.50
	105	9/18/12	0.96	0.04	0.00	0.54	0.00	0.42	0.96	0.54	0.00	0.00	0.00	0.02	0.40	29.50
	209	8/31/12	0.78	0.22	0.08	0.24	0.08	0.38	0.70	0.24	0.00	0.00	0.08	0.00	0.38	17.80
	209	9/18/12	0.98	0.02	0.02	0.40	0.00	0.56	0.96	0.40	0.00	0.00	0.00	0.00	0.56	40.60
	310	8/31/12	0.78	0.22	0.10	0.36	0.08	0.24	0.68	0.36	0.00	0.00	0.08	0.00	0.24	14.00
	310	9/18/12	0.94	0.06	0.08	0.42	0.00	0.44	0.86	0.42	0.00	0.00	0.00	0.00	0.44	24.40
	407	8/31/12	0.88	0.12	0.10	0.32	0.04	0.42	0.78	0.32	0.00	0.00	0.04	0.00	0.42	18.30
40 seeds/ft2	407	9/18/12	0.98	0.02	0.00	0.40	0.00	0.58	0.98	0.40	0.00	0.00	0.00	0.58	33.00	

Cover Crop Mix	Plot ID	Date	Percentage (1.00=100%)													Plot Height (cm)
			Total Cover	Bare Ground	Weed	Planted Grass	Planted Legume	Planted Forb	Total Planted Cover	Rye/ Triticale	Oat	Clover	Vetch	Rape	Radish	
Triticale, Red clover Hairy vetch, Radish	106	8/31/12	0.92	0.08	0.04	0.44	0.08	0.36	0.88	0.44	0.00	0.00	0.08	0.00	0.36	17.80
	106	9/18/12	1.00	0.00	0.00	0.46	0.00	0.54	1.00	0.46	0.00	0.00	0.00	0.00	0.54	33.00
	201	8/31/12	0.86	0.14	0.06	0.42	0.02	0.36	0.80	0.42	0.00	0.00	0.02	0.00	0.36	15.20
	201	9/18/12	0.90	0.10	0.00	0.32	0.00	0.58	0.90	0.32	0.00	0.00	0.00	0.00	0.58	33.50
	306	8/31/12	0.94	0.06	0.04	0.38	0.02	0.50	0.90	0.38	0.00	0.00	0.02	0.00	0.50	16.80
	306	9/18/12	1.00	0.00	0.00	0.44	0.00	0.56	1.00	0.44	0.00	0.00	0.00	0.00	0.56	29.00
	401	8/31/12	0.76	0.24	0.02	0.42	0.02	0.30	0.74	0.42	0.00	0.00	0.02	0.00	0.30	15.50
60 seeds/ft2	401	9/18/12	0.84	0.16	0.00	0.46	0.00	0.38	0.84	0.46	0.00	0.00	0.00	0.00	0.38	39.60
Triticale, Red clover, Hairy vetch, Radish, Oats, Rapeseed	107	8/31/12	0.72	0.28	0.16	0.34	0.02	0.20	0.56	0.34	0.00	0.00	0.02	0.06	0.14	11.70
	107	9/18/12	1.00	0.00	0.10	0.48	0.04	0.38	0.90	0.48	0.00	0.00	0.04	0.08	0.30	26.40
	202	8/31/12	0.78	0.22	0.28	0.32	0.04	0.14	0.50	0.32	0.00	0.00	0.04	0.00	0.14	15.70
	202	9/18/12	0.88	0.12	0.14	0.42	0.04	0.28	0.74	0.42	0.00	0.00	0.04	0.08	0.20	30.00
	302	8/31/12	0.70	0.30	0.14	0.40	0.04	0.12	0.56	0.40	0.00	0.00	0.04	0.04	0.08	10.70
	302	9/18/12	1.00	0.00	0.04	0.58	0.00	0.38	0.96	0.58	0.00	0.00	0.00	0.16	0.22	31.00
	410	8/31/12	0.64	0.36	0.18	0.32	0.04	0.10	0.46	0.32	0.00	0.00	0.04	0.00	0.10	15.70
20 seeds/ft2	410	9/18/12	0.96	0.04	0.08	0.48	0.00	0.40	0.88	0.48	0.00	0.00	0.00	0.16	0.24	38.10
Triticale, Red clover, Hairy vetch, Radish, Oats, Rapeseed	108	8/31/12	0.74	0.26	0.08	0.38	0.06	0.22	0.66	0.38	0.00	0.00	0.06	0.04	0.18	13.20
	108	9/18/12	1.00	0.00	0.00	0.52	0.02	0.46	1.00	0.52	0.00	0.00	0.02	0.18	0.28	33.50
	208	8/31/12	0.88	0.12	0.10	0.44	0.04	0.30	0.78	0.44	0.00	0.00	0.04	0.02	0.28	17.50
	208	9/18/12	0.98	0.02	0.00	0.56	0.02	0.40	0.98	0.56	0.00	0.00	0.02	0.04	0.36	43.20
	309	8/31/12	0.76	0.24	0.04	0.42	0.00	0.30	0.72	0.42	0.00	0.00	0.00	0.08	0.22	13.20
	309	9/18/12	1.00	0.00	0.04	0.54	0.00	0.42	0.96	0.54	0.00	0.00	0.00	0.10	0.32	27.40
	403	8/31/12	0.82	0.18	0.16	0.42	0.06	0.14	0.66	0.42	0.00	0.00	0.06	0.04	0.10	16.50
40 seeds/ft2	403	9/18/12	0.92	0.08	0.02	0.38	0.06	0.46	0.90	0.38	0.00	0.00	0.06	0.02	0.44	43.20
Triticale, Red clover, Hairy vetch, Radish, Oats, Rapeseed	109	8/31/12	0.84	0.16	0.04	0.44	0.02	0.34	0.80	0.44	0.00	0.00	0.02	0.10	0.24	15.20
	109	9/18/12	0.98	0.02	0.00	0.40	0.00	0.58	0.98	0.40	0.00	0.00	0.00	0.10	0.48	35.10
	206	8/31/12	0.66	0.34	0.08	0.38	0.04	0.16	0.58	0.38	0.00	0.00	0.04	0.04	0.12	13.50
	206	9/18/12	0.82	0.18	0.00	0.50	0.04	0.28	0.82	0.50	0.00	0.00	0.04	0.02	0.26	39.10
	303	8/31/12	0.80	0.20	0.04	0.42	0.02	0.32	0.76	0.42	0.00	0.00	0.02	0.04	0.28	17.30
	303	9/18/12	1.00	0.00	0.02	0.40	0.00	0.58	0.98	0.40	0.00	0.00	0.00	0.10	0.48	38.10
	408	8/31/12	0.92	0.08	0.02	0.54	0.06	0.30	0.90	0.54	0.00	0.00	0.06	0.08	0.22	19.80
60 seeds/ft2	408	9/18/12	0.98	0.02	0.00	0.48	0.04	0.46	0.98	0.48	0.00	0.00	0.04	0.10	0.36	38.60
No Cover Crop	110	8/31/12	0.50	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.50
	110	9/18/12	0.94	0.06	0.94	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.10
	207	8/31/12	0.46	0.54	0.46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.50
	207	9/18/12	0.84	0.16	0.84	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12.70
	305	8/31/12	0.42	0.58	0.42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.50
	305	9/18/12	0.86	0.14	0.86	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.60
	406	8/31/12	0.42	0.58	0.42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.50
406	9/18/12	0.94	0.06	0.94	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	22.90	

Table CC-6. 2012 Crop biomass and botanical composition

Cover Crop Mix	Sample Date	Plot ID	(DM) Total aboveground lb/acre	(DM) Radish Root lb/acre	Botanical Composition of Aboveground Biomass, Decimal %					Above ground (DM) Total N %	Radish (root) (DM) Total N %
					Weed	Grass	Legume	Rape	Radish (top)		
Triticale, Red clover	09/21/12	101	3404	.	0.027	0.973	0.000	.	.	5.0	
	09/21/12	205	3189	.	0.263	0.737	0.000	.	.	5.2	
	09/21/12	307	3534	.	0.136	0.864	0.000	.	.	5.0	
20 seeds/ft ²	09/21/12	405	3826	.	0.200	0.800	0.000	.	.	7.6	
Triticale, Red clover	09/21/12	102	2753	.	0.081	0.918	0.000	.	.	5.0	
	09/21/12	210	3435	.	0.019	0.981	0.000	.	.	5.0	
	09/21/12	304	3503	.	0.089	0.911	0.000	.	.	4.8	
40 seeds/ft ²	09/21/12	409	4137	.	0.001	0.998	0.000	.	.	5.0	
Triticale, Red clover	09/21/12	103	4877	.	0.020	0.979	0.000	.	.	4.8	
	09/21/12	203	3676	.	0.014	0.985	0.000	.	.	4.8	
	09/21/12	301	3529	.	0.019	0.981	0.000	.	.	5.4	
60 seeds/ft ²	09/21/12	402	3411	.	0.028	0.971	0.000	.	.	4.9	
Triticale, Red clover, Hairy vetch, Radish	09/21/12	104	4877	556	0.210	0.318	0.007	.	0.465	4.8	4.1
	09/21/12	204	3386	298	0.098	0.514	0.000	.	0.387	5.3	3.7
	09/21/12	308	4051	323	0.150	0.456	0.023	.	0.371	5.5	4.2
20 seeds/ft ²	09/21/12	404	2637	135	0.144	0.684	0.017	.	0.155	5.3	3.8
Triticale, Red clover, Hairy vetch, Radish	09/21/12	105	4352	403	0.027	0.337	0.001	.	0.635	5.0	4.2
	09/21/12	209	4055	187	0.015	0.513	0.012	.	0.460	5.9	4.3
	09/21/12	310	3579	336	0.035	0.491	0.021	.	0.452	5.4	4.1
40 seeds/ft ²	09/21/12	407	3872	357	0.052	0.614	0.017	.	0.318	5.3	4.1
Triticale, Red clover, Hairy vetch, Radish	09/21/12	106	4653	188	0.020	0.546	0.008	.	0.426	5.3	4
	09/21/12	201	4274	362	0.074	0.424	0.006	.	0.496	5.1	4.3
	09/21/12	306	4877	309	0.000	0.484	0.009	.	0.507	5.5	4.6
60 seeds/ft ²	09/21/12	401	4288	226	0.009	0.544	0.009	.	0.438	5.6	4.4
Triticale, Red clover, Hairy vetch, Radish, Oats, Rapeseed	09/21/12	107	2813	242	0.068	0.647	0.030	0.094	0.160	5.3	3.6
	09/21/12	202	4088	282	0.070	0.655	0.042	0.047	0.187	5.2	4.5
	09/21/12	302	3435	0	0.306	0.681	0.013	0.001	0.000	5.5	0
20 seeds/ft ²	09/21/12	410	4058	140	0.097	0.575	0.024	0.008	0.297	5.4	3.7
Triticale, Red clover, Hairy vetch, Radish, Oats, Rapeseed	09/21/12	108	3604	204	0.034	0.652	0.017	0.000	0.297	5.2	3.9
	09/21/12	208	3920	476	0.051	0.510	0.007	0.000	0.432	5.3	4.2
	09/21/12	309	4406	76	0.059	0.712	0.010	0.046	0.172	5.0	4.7
40 seeds/ft ²	09/21/12	403	4317	227	0.008	0.731	0.016	0.000	0.245	5.4	4.4
Triticale, Red clover, Hairy vetch, Radish, Oats, Rapeseed	09/21/12	109	3558	107	0.000	0.624	0.011	0.103	0.262	5.4	4.2
	09/21/12	206	4498	266	0.016	0.455	0.021	0.103	0.404	5.4	4.2
	09/21/12	303	4628	144	0.001	0.623	0.020	0.091	0.266	5.4	4.3
60 seeds/ft ²	09/21/12	408	3848	211	0.017	0.590	0.005	0.084	0.304	5.1	4.3
no cover crop	09/21/12	110	1824	.	1.000	.	.	.	.	4.5	
	09/21/12	207	3441	.	1.000	.	.	.	.	5.0	
	09/21/12	305	2984	.	1.000	.	.	.	.	4.6	
	09/21/12	406	2322	.	1.000	.	.	.	.	4.7	

Table CC-7. (2012-ND) Soil chemical properties and soil health					
Sampling Period	Solvita 1 day CO ₂ -C ppm	Organic C ppm	Organic N ppm	Organic C:N ppm	Soil Health Calculation ^{1/}
Cover Crop Planting	36.7	376*	40*	9.6*	11.7*
Cover Crop Termination	33.9	398	62	6.7	15.4

* Significant at P<0.05

^{1/} Soil Health Calculation = Solvita 1 day CO₂-C/organic C:N ratio plus a weighted Organic C and Organic N

Table CC-8. (2012-ND) Nitrogen, phosphate and potash levels			
Sampling Period	N lb/ac	P lb/ac	K lb/ac
Cover Crop Planting	357*	495*	940*
Cover Crop Termination	264	518	884

* Significant at P<0.05

Table CC-9. (2012-ND) Inorganic P, organic P and total P			
Sampling Period	Inorganic P lb/ac	Organic P lb/ac	Total P ^{1/} lb/ac
Cover Crop Planting	489	186*	675
Cover Crop Termination	510	132	642

* Significant at P<0.05

^{1/} Total P = Inorganic P + Organic P

Table CC-10. (2012-ND) Inorganic N, organic N and total N			
Sampling Period	Inorganic N lb/ac	Organic N lb/ac	Total N ^{1/} lb/ac
Cover Crop Planting	345*	81*	426*
Cover Crop Termination	243	123	366

* Significant at P<0.05

^{1/} Total N = Inorganic N + Organic N

Table CC-11. Seeding rate effects on growth and production of triticale and red clover mix							
Seeding Rate ^{1/} seeds/ft ²	Yield DM lb/ac	N content %	N Uptake ^{2/} lb/ac	Canopy cover 30 day %	Canopy cover 50 day %	Canopy height 30 day %	Canopy height 50 day %
20	3488	5.03	175	42 a ^{3/}	74 a	12 a	28
40	3457	4.95	171	54 ab	90 b	16 b	31
60	3873	4.98	192	66 b	93 b	18 b	32

^{1/} Percent of triticale and red clover in mix are 50 and 50
^{2/} N uptake = DM yield * N content/100
^{3/} Means within a column followed by the same letters are not significantly different at p<0.05

Table CC-12. Seeding rate effects on growth and production of triticale, red clover, hairy vetch, and radish mix							
Seeding Rate ^{1/} seeds/ft ²	Yield DM lb/ac	N content %	N Uptake ^{2/} lb/ac	Canopy cover 30 day %	Canopy cover 50 day %	Canopy height 30 day %	Canopy height 50 day %
20	3738	5.23	194	57 a ^{3/}	92	13	31
40	3965	5.40	214	74 b	94	16	32
60	4523	5.38	243	83 b	94	16	34

^{1/} Percent of triticale, red clover, hairy vetch and radish in mix are in mix are 45, 23,23, and 10, respectively
^{2/} N uptake = DM yield * N content/100
^{3/} Means within a column followed by the same letters are not significantly different at p<0.05

Table CC-13. Seeding rate effects on growth and production of triticale, red clover, hairy vetch, radish, oat, rapeseed mix							
Seeding Rate ^{1/} seeds/ft ²	Yield DM lb/ac	N content %	N Uptake ^{2/} lb/ac	Canopy cover 30 day %	Canopy cover 50 day %	Canopy height 30 day %	Canopy height 50 day %
20	3595	5.35	192	52 a ^{3/}	87	13	31
40	4062	5.23	212	71 b	96	15	37
60	4133	5.33	220	76 b	94	16	38

^{1/} Percent of triticale, red clover,hairy vetch,radish,oat,rapeseed are 23,23,23,23,5,and 5 respectively
^{2/} N uptake = DM yield * N content/100
^{3/} Means within a column followed by the same letters are not significantly different at p<0.05

Table CC-14. Contribution of triticale, red clover by seeding rate and weeds to total dry matter yield							
Seeding Rate ^{1/}	Total DM	Triticale		Red clover		Weed	
seeds/ft ²	lb/ac	lb/ac		lb/ac		lb/ac	
20	3488	2944 a ^{2/}	(84%) ^{3/}	0.75 b	(<1%)	543 b	(16%)
40	3457	3305 a	(96%)	0.71 b	(<1%)	151 b	(4%)
60	3873	3794 a	(98%)	0.70 b	(<1%)	79 b	(2%)

^{1/} Percent of triticale and red clover in mix are 50 and 50
^{2/} Means within a row followed by the same letter are not significantly different at P<0.05
^{3/} Percent of total yield contributed by each vegetation group

Table CC-15. Contribution of vegetation groups(triticale,red clover,hairy vetch,radish) by seeding rate and weeds to total dry matter yield								
Seeding Rate ^{1/}	Total DM	Grass		Legume ^{2/}		Radish		Weed
seeds/ft ²	lb/ac	lb/ac		lb/ac		lb/ac		lb/ac
20	3738	1735 a ^{3/}	(46%) ^{4/}	43 b	(1%)	1373 a	(37%)	587 b (16%)
40	3965	1921 a	(48%)	48 b	(1%)	1869 a	(47%)	127 b (3%)
60	4523	2261 a	(50%)	36 b	(<1%)	2114 a	(47%)	112 b (2%)

^{1/} Percent of triticale, red clover, hairy vetch and radish in mix are in mix are 45, 23,23, and 10, respectively
^{2/} Red clover and hairy vetch
^{3/} Means within a row followed by the same letters are not significantly different at P< 0.05
^{4/} Percent of total yield contributed by each vegetation group

Table CC-16. Contribution of vegetation groups (triticale, red clover, hairy vetch, oat, radish, rapeseed) by seeding rate and weeds to total dry matter yield							
Seeding Rate ^{1/} seeds/ft ²	Total DM lb/ac	Grass lb/ac		Legume ^{2/} lb/ac	Radish lb/ac	Rapeseed lb/ac	Weed lb/ac
20	3595	2293 a ^{3/}	(64%) ^{4/}	99 b (3%)	604 b (17%)	119 b (3%)	481 b (13%)
40	4062	2661 a	(66%)	51 c (1%)	1145 b (28%)	51 c (1%)	154 c (4%)
60	4133	2356 a	(57%)	61 c (1%)	1288 b (32%)	392 c (9%)	36 c (<1%)

^{1/} Percent of triticale, red clover, hairy vetch, radish, oat, and rapeseed in mix are 23, 23, 23, 23, 5 and 5, respectively
^{2/} Red clover and hairy vetch
^{3/} Means within a row followed by the same letters are not significantly different at P < 0.05
^{4/} Percent of total yield contributed by each vegetation group

Table CC-17. Radish root yield, N content and N uptake in triticale, red clover, and hairy vetch cover crop mix by seeding rate			
Seeding Rate ^{1/} seeds/ft ²	Yield DM lb/ac	N content %	N Uptake ^{2/} lb/ac
20	328	4.08	14
40	321	4.25	14
60	271	4.23	12

^{1/} percent of triticale, red clover, hairy vetch and radish in mix are 45, 23, 23, and 10, respectively
^{2/} N uptake = DM yield * N content/100

Table CC-18. Radish root yield, N content and N uptake in triticale, red clover, hairy vetch, oat, and rapeseed cover crop mix by seeding rate			
Seeding Rate ^{1/} seeds/ft ²	Yield DM lb/ac	N content %	N Uptake ^{2/} lb/ac
20	187	3.97	7
40	246	4.15	10
60	182	4.33	8

^{1/} Percent of triticale, red clover, hairy vetch, radish, oat, and rapeseed are 23, 23, 23, 23, 5 and 5 respectively
^{2/} N uptake = DM yield * N content/100

CONSERVATION FIELD TRIALS

CONSERVATION FIELD TRIALS: TECHNICAL REPORT 2011-2012

Number and Title: NDPMC-F-0703-PA Grass/Legume/Forb Demonstration, Wessington Springs, South Dakota

Objective: Compare performance differences among species and varieties of various grasses, forbs, and legumes. The site will be used for education and demonstration and is open for public viewing.

Date Seeded: May 15, 2007

Cooperators: Jerauld County Conservation District and the USDA-NRCS, Wessington Springs, South Dakota

Figure WS-1. Plot layout of grass/forb demonstration at Wessington Springs, South Dakota, planted 5/15/2007.



Methods and Materials: There are 51 plots of various grasses, legumes, forbs, and mixtures of each. They were seeded with a 6-foot plot drill. The drill consisted of a cone-seeder attachment for each opener so individual rows were metered separately. Plot size is 12 feet by 48 feet with 16 rows per plot for the grass plots. The forb and selected legumes plots were 28 feet in length and the same width. There are 6-foot borders separating each plot and larger borders on the ends. These areas were seeded to Bad River ecotype blue grama. Two larger plots about ½-acre each along the sides of the demonstration area were seeded to an introduced and a native mixture. The south side plot was seeded to an introduced mixture of 35% ‘Reliant’ intermediate wheatgrass, 35% ‘Fleet’ meadow brome grass, and 30% ‘Travois’ alfalfa. The north side plot was seeded to a native mixture of 10 species at 10% each. These included ‘Bonilla’ big bluestem, Bad River ecotype blue grama, ‘Lodorm’ green needlegrass, ‘Tomahawk’ Indiangrass, Badlands ecotype little bluestem, needle-and-thread, ‘Goshen’ prairie sandreed, ‘Pierre’ sideoats grama, ‘Forestburg’ switchgrass, and ‘Rodan’ western wheatgrass. See Figure WS-1 for plot layout.

Site Information: The site was previously planted to alfalfa. The soils are a Lane silty clay loam and the Ecological Site Description is clayey. The site is level. The property is owned by the Jerauld Conservation District and is located on the north edge of Wessington Springs, South Dakota, adjacent to a county highway. The land was sprayed and tilled in 2006. A seedbed was prepared in the spring of 2007 by cultivating, harrowing, and roller packing. Above average rainfall was received in April and May. The plots and borders were mowed twice for weed control during the growing season.

Table WS-1. Plant performance at the Jerauld County Demonstration Site. In each column the first entry is for 2007, the second is for 2008, the third is for 2009, and the fourth is for 2010. The last column is forage production lbs/ac clipped from a 2’ x 10’ strip on September 9, 2010 with a forage harvester. Samples are oven-dried weights. Plots with NC were not clipped.

Common name/Variety (VNS=variety not stated)	(1) Weed Competition	(2) Stand Rating	(3) Vigor	Forage lbs/ac
Crested wheatgrass/AC2	3-2-2-4	4-1-1-3	2-1-1-1	3204
Wheatgrass hybrid/NewHy	2-1-1-2	2-1-1-1	1-1-1-1	3735
Timothy/Climax	6-5-4-5	7-5-4-4	3-2-2-2	2651
Orchardgrass/Latar	5-6-4-5	5-6-4-3	3-3-2-3	1922
Russian wildrye/Mankota	4-3-2-2	4-3-2-2	2-2-2-2	2241
Altai wildrye/VNS	5-6-3-2	3-3-2-1	2-3-2-2	6048
Dahurian wildrye/Arthur	1-1-3-4	2-1-3-4	1-1-3-5	1711
Smooth brome grass/Rebound	2-1-1-1	2-1-1-1	1-1-1-1	5115
Meadow brome grass/Fleet	2-1-1-2	2-1-1-2	1-1-1-1	3721
Intermediate wheatgrass/Reliant	2-1-1-1	2-1-1-1	1-1-1-1	8308
Intermediate wheatgrass/Manifest	3-2-1-1	3-2-1-1	3-1-1-1	7330
Intermediate wheatgrass/Haymaker	2-1-1-1	2-1-1-1	1-1-1-1	6849
Intermediate wheatgrass/Beefmaker	2-1-1-1	2-1-1-1	1-1-1-1	7509
Pubescent wheatgrass/Manska	3-1-1-1	3-1-1-1	2-1-1-1	7741
Tall wheatgrass/Alkar	2-1-1-1	2-1-1-1	3-1-1-1	9113
Prairie junegrass/VNS	8-8-8-8	8-8-8-8	NA	NC
Slender wheatgrass/Pryor	4-4-5-3	4-3-4-3	4-1-3-2	6379
Western wheatgrass/Rodan	3-4-5-5	4-4-4-4	2-2-2-3	2785
Canada wildrye/Icy Blue	3-3-3-3	4-3-3-3	4-2-2-2	4193
Canada wildrye/Mandan	3-2-2-2	2-2-1-2	2-1-1-2	2828
Green needlegrass/Lodorm	3-3-3-2	3-2-2-2	3-1-2-1	4254
Porcupinegrass/VNS	5-8-6-5	6-6-3-4	5-5-3-3	3279
Needle-and-thread/VNS	4-4-6-8	4-3-4-8	4-2-4-NA	NC
Buffalograss/Bowie	2-3-6-7	2-2-2-6	1-1-3-3	2416
Blue grama/Bad River	3-3-6-6	3-2-4-5	3-1-3-4	1882
Little bluestem/Badlands	5-6-4-5	5-6-4-3	4-4-2-4	5328
Sideoats grama/Pierre	3-5-3-3	3-4-3-3	3-2-2-4	2050

Big bluestem/Bonilla	4-4-3-2	4-3-3-2	4-3-2-1	5969
Switchgrass/Forestburg	5-6-3-3	4-5-3-1	5-4-2-1	4801
Indiangrass/Tomahawk	5-6-4-2	5-6-3-2	4-4-3-2	3959
Meadow brome (Fleet)+ alfalfa (Travois)	2-1-2-2	2-1-2-2	2-1-2-2	3923
Intermediate (Reliant) + cicer (Lutana)	2-2-2-2	2-2-2-2	2-2-2-2	5975
Western (Rodan) + green needle (Lodorm) + purple prairieclover (Bismarck)	4-3-2-2	4-2-2-2	4-2-2-2	3959
Sideoats (Pierre) + little blue (Badlands) + purple prairieclover (Bismarck)	4-6-3-3	4-5-3-3	4-4-3-3	NC
Cicer milkvetch/Lutana	4-4-2-2	4-2-1-1	3-3-2-2	5321
Alsike clover/VNS	2-2-8-8	2-2-8-8	2-2-NA-NA	NC
Ladino white clover/VNS	4-3-8-8	4-3-8-8	3-3-NA-NA	NC
Red clover/Kenland	3-2-6-3	2-2-3-2	2-3-3-2	5053
Alfalfa/Travois	2-1-2-4	2-1-1-3	2-1-3-5	4514
Yellow alfalfa/SDSU	3-2-2-2	3-1-1-1	3-1-2-1	5201
Birdsfoot trefoil/Dawn	2-2-2-3	2-1-1-2	2-1-3-3	5391
Sainfoin/Eski	2-2-5-6	3-1-4-6	3-1-6-6	NC
Sideoats (Pierre) + Purple prairieclover (Bismarck)	4-4-4	4-4-3	4-4-3-5*	NC
Sideoats (Pierre) + White prairieclover (Antelope)	4-4-5	4-3-4	4-4-3-5*	NC
Sideoats (Pierre) + Canada milkvetch (9069117)	4-5-6	6-6-5	4-5-3-5*	NC
Sideoats (Pierre) + Illinois bundleflower (MN)	4-5-5	4-5-4	4-5-3-7*	NC
Sideoats (Pierre) + Blue flax (Appar)	4-3-4	4-2-3	4-3-3-7*	NC
Sideoats (Pierre) + Yellow coneflower (Stillwater)	5-3-6	5-3-5	5-3-3-8*	NC
Sideoats (Pierre) + Blanketflower (VNS)	4-3-7	4-4-6	4-3-3-7*	NC
Sideoats (Pierre) + Maximilian sunflower (Medicine Creek)	5-5-4	5-5-4	5-5-3-3*	NC
Sideoats (Pierre) + Stiff sunflower (Bismarck)	4-4-3	4-4-2	4-4-2-4*	NC

(1) 1 = no weeds, 9 = all weeds

(2) 1 = highest, 9 = lowest

(3) 1 = highest, 9 = lowest

*Forb only rated

Results and Discussion:

2007: The plots were off to a good start after seeding. Evaluation ratings were taken on August 24, 2007, on stand, vigor, and weed competition (see Table WS-1 for performance information). ‘NewHy’ hybrid wheatgrass, ‘Arthur’ Dahurian wildrye, ‘Rebound’ smooth brome grass, Fleet meadow brome grass, ‘Alkar’ tall wheatgrass, ‘Mandan’ Canada wildrye, and all of the intermediate wheatgrass varieties established well and had stand ratings of 2. ‘Bowie’ buffalograss also looked very good and was the only warm-season entry to have an initial stand rating of 2. ‘Climax’ timothy and prairie junegrass did not establish well. Comparing the legumes, alsike clover, ‘Kenland’ red clover, Travois alfalfa, and ‘Dawn’ birdsfoot trefoil were off to a good start and had stand ratings of 2. The forb plantings (with sideoats grama) and the grass/legume mixtures generally had stand ratings of 4 to 6 and were slower to establish. Weed competition and vigor ratings varied considerably across all plots. The larger sized native and introduced mixture plots seeded on the north and south ends, established well.

2008: Notes were taken on July 21, 2008. Generally, there was less weed competition and most cool-season entries had higher stand ratings in 2008. The brome grass entries (both smooth and meadow), tall wheatgrass, and pubescent/intermediate wheatgrass varieties had excellent stands and heavy biomass. NewHy hybrid wheatgrass and Arthur Dahurian wildrye performed very well. Canada wildrye had good stands with Mandan rated slightly better in stand and vigor compared to ‘Icy Blue’. The stand of green needlegrass had improved from 2007 to 2008. The plot of Bowie buffalograss was again rated very good. Other warm-season grass species were rated somewhat lower than expected. Bonilla big bluestem had the best stand and Pierre sideoats grama the highest vigor rating.

Travois alfalfa, SDSU yellow alfalfa, 'Eski' sainfoin, and Dawn alfalfa performed the best of the legumes. The blanketflower, yellow coneflower, and blue flax were very showy in the spring and were rated good for stands. The sunflowers had the poorest stands of the forbs. Both the larger plot native and introduced mixture seedings performed well and had been mowed.

2009: Notes were taken on September 18, 2009. Generally, the cool-season grasses established most rapidly and had the least weed contamination. Warm-season grass species were slower, but many entries had good stands in 2009. Forb and legume species had the most variability in performance. Some of the species with outstanding performance in 2009 included Fleet meadow brome grass, NewHy hybrid wheatgrass, Alkar tall wheatgrass, AC2 crested wheatgrass, Rebound smooth brome grass, all five varieties of pubescent/intermediate wheatgrass, Mandan Canada wildrye, Lodorm green needlegrass, Pierre sideoats grama, Bowie buffalograss, Lutana cicer milkvetch, Travois alfalfa, SDSU yellow-blossom alfalfa, and Dawn birdsfoot trefoil. A few of the poorer performing entries included prairie junegrass, alsike clover, and Ladino white clover. Patches of wild lettuce were scattered throughout the planting. The mixtures were harder to evaluate. Sideoats grama performed fairly well in the mixes and was not so aggressive that it took over the plot. Bad River blue grama worked well seeded as a border between entries. It allowed the observers to walk down the length of every plot without walking into the plot. Consideration will be given next year to sampling forage production in selected plots.

2010: A tour in conjunction with a plant materials training session was held on July 21, 2010. The plots were clipped and rated on September 10, 2010. Contaminated or poor performing plots were not harvested. A flail-knife forage harvester was used to clip a 2' x 10' strip in each plot. Contaminant weeds and other grasses were removed before clipping. NRCS and Conservation District employees helped with the clipping. Grab samples were collected and brought back to the PMC for oven drying. After drying the samples were weighed again to determine dry-down. The samples averaged 30%-40% moisture. Tall wheatgrass had the highest forage production at over 9000 lbs/ac. The intermediate/pubescent wheatgrass entries were in the 7000-8000 lbs/ac range. Big bluestem had the highest production of the warm-season entries at almost 6000 lbs/ac. Cicer milkvetch, yellow-blossom alfalfa, and red clover all produced more than 5000 lbs/ac compared to 4500 lbs/ac for the alfalfa entry. Some of the shorter life span species were gone. The larger mixture plots on the ends were also clipped. The meadow brome, intermediate wheatgrass, and alfalfa mix produced 5421 lbs/ac compared to the ten species silty range site mix which produced 7723 lbs/ac.

2011: Plots were evaluated to determine which of the plots would be terminated due to contamination from other species and weeds, and poor stands. Plots selected for termination were Plots 3 and 4, and plots 7-15. They are to be replanted to the same species in the spring of 2012.

2012: Several plots were clipped on 2/15/12 and tested for forage quality for winter grazing potential. Table W-S2 lists the species that were clipped and analyzed for forage quality. Cicer milk vetch, Russian wildrye, blue grama, Dahurian wildrye, and Fleet meadow brome were highest in crude protein and relative feed value as compared to the other species in the quality sampling. The plots indicated for termination in 2011 were tilled for re-seeding in May, 2012. Soil conditions were not very conducive for seeding when the plots were seeded on May 16th. The seedbed was extremely chunky and dry due to soil and climatic conditions at the time. The following species (mostly forbs) were planted in the same original plot sites: blanketflower, yellow coneflower, blue flax, Illinois bundleflower, Canada milkvetch, white prairieclover, purple prairieclover, sainfoin, birdsfoot trefoil, timothy, and orchardgrass. Observations in July indicated poor emergence and grasshopper infestations, all due to seedbed conditions and drought across a large area in the southern portion of the Northern Great Plains.

Table WS-2. Forage analysis of grasses for winter grazing at Wessington Springs, South Dakota (clipped February 15, 2012)

Plot #	Species	% CP	% NDF	% ADF	% Ash	DMI	DDM	RFV
	Lutana cicer milkvetch	10.78	60.12	45.45	7.59	2.00	53.50	82.78
1	AC2 crested wheatgrass	2.60	81.07	49.91	6.67	1.48	50.02	57.40
2	NewHy wheatgrass X	4.41	75.55	46.41	10.33	1.59	52.75	64.95
3	Climax timothy	3.45	77.24	48.26	5.66	1.55	51.31	61.79
4	Latar orchardgrass	4.05	73.16	44.18	9.34	1.64	54.49	69.28
5	Mankota Russian wildrye	9.63	68.96	40.36	10.08	1.74	57.46	77.52
6	VNS Altai wildrye	3.52	82.28	51.82	5.45	1.46	48.54	54.87
7	Arthur Dahurian wildrye	5.57	69.20	41.46	14.34	1.73	56.60	76.09
8	Rebound smooth brome	3.32	76.42	45.65	10.38	1.57	53.34	64.93
9	Fleet meadow brome	5.44	69.02	44.74	13.87	1.74	54.05	72.85
10	Reliant intermediate wheatgrass	2.05	78.72	48.79	9.92	1.52	50.89	60.14
11	Manifest intermediate wheatgrass	2.05	77.70	48.50	10.33	1.54	51.12	61.20
14	Manska pubescent wheatgrass	2.56	78.88	50.27	10.03	1.52	49.74	58.66
15	Alkar tall wheatgrass	2.75	76.72	48.35	11.18	1.56	51.24	62.12
18	Rodan western wheatgrass	3.81	74.54	45.02	12.30	1.61	53.83	67.18
21	Lodorm green needlegrass	3.47	79.71	48.84	11.26	1.51	50.85	59.35
24	Bowie buffalograss	4.18	77.95	39.00	14.02	1.54	58.52	69.84
25	Bad River blue grama	5.76	72.40	38.86	15.46	1.66	58.63	75.33
27	Pierre sideoats grama	3.20	75.13	43.35	16.80	1.60	55.13	68.26
28	Bonilla big bluestem	1.61	83.31	54.22	7.50	1.44	46.67	52.11
29	Forestburg switchgrass	1.62	82.29	50.61	6.33	1.46	49.48	55.93
30	Tomahawk Indiangrass	1.20	82.85	50.99	7.72	1.45	49.18	55.22
32	Reliant intermediate wheatgrass Lutana cicer milkvetch	3.12	79.47	48.96	9.89	1.51	50.76	59.42
	Blue Grama (alley), clipped late July	4.58	72.63	37.57	15.62	1.65	59.64	76.38

CONSERVATION FIELD TRIALS: TECHNICAL REPORT 2011-2012

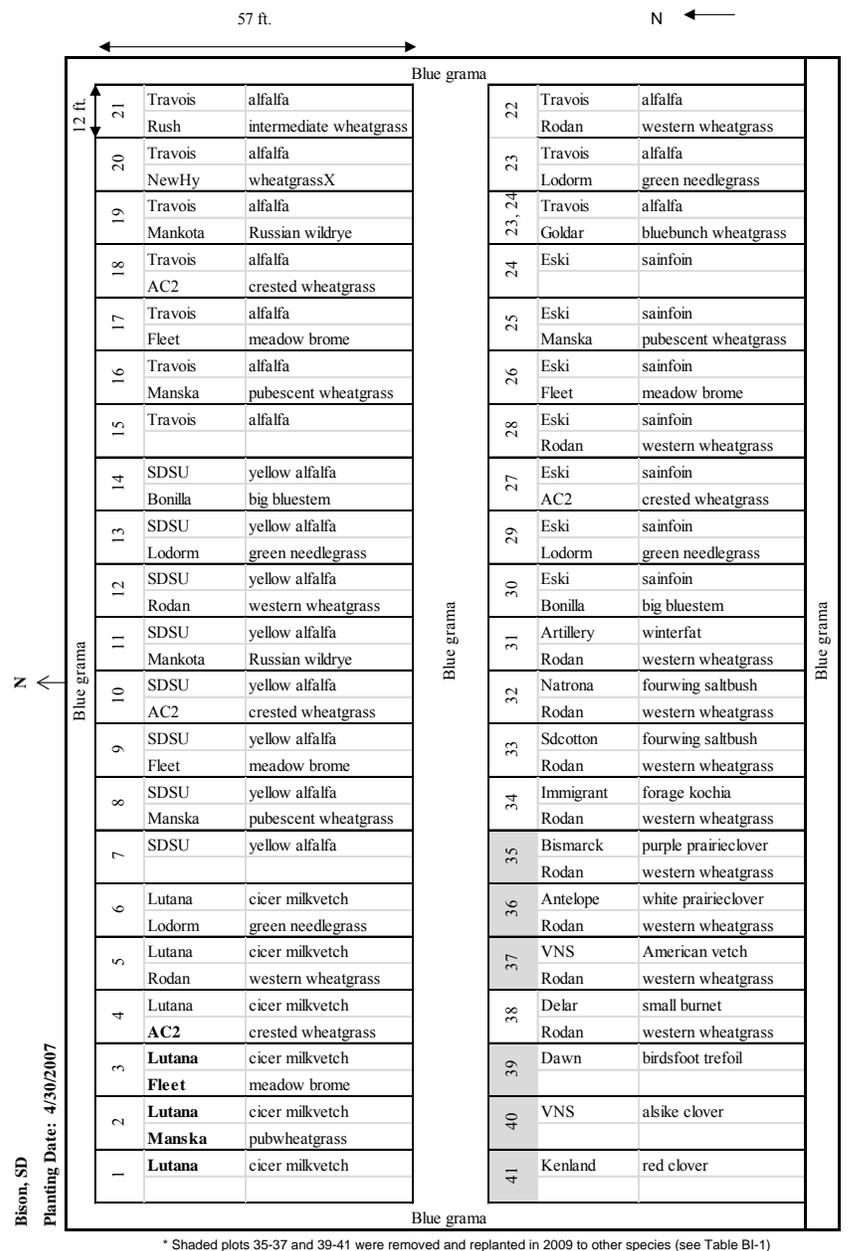
Number and Title: SDPMC-F-0704-PA Grass/Legume/Forb Demonstration, Bison, South Dakota

Objective: Compare performance differences and compatibility among various grass and legume species for grazing and hayland use. Various forb and shrub species will also be tested. The site will be used for education and demonstration and is open for public viewing.

Date Seeded: April 30, 2007

Cooperators: Perkins County Conservation District, Tatanka Resource Conservation and Development, USDA Farm Service Agency, and USDA, Natural Resources Conservation Service, Bison, South Dakota.

Figure BI-1. Plot layout of grass/forb demonstration at Bison, South Dakota, planted 4/30/2007.



Methods and Materials: Forty-two plots of various grasses, legumes, forbs, and mixtures of each were seeded with a 6-foot plot drill. The drill consisted of a cone-seeder attachment for each opener so individual rows were metered separately. Plot size is 12 feet by 57 feet with 16 rows per plot for the grass plots. A border area around and between the two sets of plots was seeded to Bad River ecotype blue grama. See Figure BI-1 for plot layout.

Site Information: The site was previously seeded small grains; the surrounding land was seeded to an introduced grass mix for CRP. The soils are a Reeder loamy. The site is level. The property is owned by Jim Lyon and is located on the south side of Highway 20 about 25 miles east of Bison, South Dakota. A seedbed was prepared in the spring of 2007 by cultivating and harrowing. Rainfall was received after seeding but amounts were marginal for good germination. The summer was dry and below average for precipitation. The plots and borders were mowed once for weed control during the growing season. Russian thistle and foxtail were the main weed species.

Results and Discussion:

2007: The plots were off to a slow start after seeding primarily due to low rainfall. Evaluation ratings were taken on July 27, 2007, for stand density (see Table BI-1 for performance information). The main weed competition was Russian thistle and foxtail. Weed competition and vigor ratings varied considerably across all plots. The legumes with the highest stand ratings were both alfalfas and sainfoin. The best grass stands were pubescent wheatgrass ('Manska'), crested wheatgrass, hybrid wheatgrass, Russian wildrye, and meadow brome grass. The shrubs and other legumes were rated poor.

2008: Weed competition was less of a problem in 2008, although there was still a fairly heavy blanket of Russian thistle seedlings in the spring. Bromoxynil herbicide was applied on the grass and legume plots in May with good results. Notes were taken on July 22. A field day tour of the plots for about 30 participants was also held on that day. Field office staff also reviewed the plots at the end of the growing season. Meadow brome grass performed very well, as did pubescent and crested wheatgrass. Stands of western wheatgrass and green needlegrass are slowly improving. Plots of big bluestem are weak, but seem to be filling in also. The hybrid wheatgrass looked good as did Russian wildrye. The bluebunch wheatgrass stand was rated poor. Bad River ecotype blue grama planted in the border area between and around the two sets of plots established quickly and the stand is rated very good. Cicer milkvetch was off to a slow start, possibly because the seed was not scarified. The cicer milkvetch stands are improving. 'Travois' alfalfa had the best stand ratings, and best production of the legumes. The yellow blossom alfalfa stands are thin, but getting thicker. The sainfoin plots had fair stands, but total production was low. The small burnet plot looked better in 2007 than it did in 2008, and was rated poor overall. Other shrubs and forb species planted in the southwest corner of the plots did not establish a stand and may be removed next year.

2009: Spring and mid-summer rainfall was above normal. Plots 36 to 42 were reseeded to various entries, except for plot 39 (small burnet/green needlegrass). The new seeding did not establish and no information was collected. Selected plots were clipped with a forage harvester on July 21, 2009, to determine forage production. Weeds and contaminant species were removed from the plots before clipping. Samples were oven dried. The highest yielding plot was yellow-blossom alfalfa and western wheatgrass at 7456 lbs/ac. Straight Travois alfalfa was second at 6477 lbs/ac. Several plots yielded over 50,000 lbs/ac. Other data was also collected at that time. Plots that were rated high in previous years continued to perform well and were in good vigor. Grass varieties/species rated high were Manska intermediate wheatgrass, Fleet meadow brome grass, AC2 crested wheatgrass, and NewHy hybrid wheatgrass. Legumes doing the best were the SDSU yellow-blossom alfalfa and Travois alfalfa. Eski sainfoin performed fairly well with meadow brome grass, pubescent wheatgrass, and crested wheatgrass. Weeds were not much of a problem except for entries with poor stands.

2010: A tour in conjunction with a plant materials training session was held on July 22, 2010. The plots were evaluated at that time. Production overall looked good, but probably not quite as good as what was clipped in 2009. The cicer milkvetch gets better every year. Both the yellow-blossom and purple-blossom alfalfa continue to perform well. The sainfoin stand is getting thinner. Pubescent wheatgrass, meadow brome grass, and the NewHy hybrid wheatgrass (now called green wheatgrass) continue to rate highest of the grasses. The shrubs have not done well, and generally there are only a few plants in each plot.

2011: Plots were clipped on July 9, 2011. Clipped production was extremely high after another season of above-normal precipitation. Yellow and purple-blossom alfalfas continue to perform well. There was considerable grasshopper damage on the Trefoil alfalfa, while the yellow did not appear to be affected.

Sainfoin is continuing to decline. Cicer milkvetch is making slight stand improvement. Grasses in the yellow alfalfa plots are declining with the exception of Manska pubescent wheatgrass and crested wheatgrass.

2012: Selected plots were clipped for production and forage quality on July 18th. Precipitation over the plots was much below normal this season and production was considerably less than previous years as a result. Yellow and purple blossom alfalfas continue to perform well in both single and mixed plots. Some plots are being invaded with crested wheatgrass and cheat grass. Forage quality and yield data indicate the yellow alfalfa in the single species plot and in the mixed plots performed extremely well for forage yield and total production of crude protein and TDN (Tables BI-1 and BI-2). The late 2012 clipping date was more conducive to yield, but had a negative impact on quality, especially in the cool season grasses. Other observations are included in the summary that follows.

Summary: Final evaluation and harvest results are shown in Table BI-1 below. The yellow alfalfa performed extremely well in this trial, both individually and in the grass mixes. It maintained a very respectable stand and very good production. Most of the grasses however, showed significant stand decline in the yellow alfalfa mix. Travois alfalfa and accompanying grasses also performed well and maintained a respectable stand throughout the trial period. Cicer milkvetch did not establish as well, but the stand did improve over time where it was seeded alone. It was not very competitive with most grasses in the mix. Sainfoin established better but declined in stand and productivity regardless of whether it was seeded alone or in a grass mix. Remaining forbs originally seeded in the plots did not perform well and several were removed and those plots were replanted to the species shown in Table BI-1. Crested wheatgrass and Manska pubescent wheatgrass maintained a good stand in all mixes. Crested wheatgrass and cheat grass were invading several plots after five years. Most other cool season grasses maintained or improved stand over time except in the yellow alfalfa mix. Western wheatgrass established slowly in all plots, but continued to improve in future years in most plots. Big bluestem did not establish or perform very well in this trial, except in extremely wet 2011. Table BI-1 provides six years of evaluation data and three years of production data for the trial period. Missing data is usually indicative of lack of a representative sample in the respective plot. Best stands were given a rating of one (1) while poorest stands were rated nine (9). Ratings are in order of consecutive years, beginning in 2007. Table BI-2 data provides forage quality information from 2012 only, the driest of the three years that the plots were clipped. Entries are ranked from highest to lowest protein.

Table BI-1. Grass, legume, and forb field trial evaluation and harvest summary at Bison, South Dakota

	Stand Rating (1=best;9=poorest) Over consecutive years		Clipping Dates/Production (lbs/ac)			
	Legume	Grass	07/21/09	08/09/11	07/18/12	Avg
Lutana cicer milkvetch	8-8-5-3-1-5		1210	3637	1089	1,979
+ Manska pubescent wheatgrass	8-8-7-7-7-8	6-4-2-3-2-2	3596	4339	843	2,926
+ Fleet meadow brome	8-8-8-8-8-8	5-3-2-2-1-2	2954	3319	503	2,258
+ AC2 crested wheatgrass	8-8-8-8-7-8	4-3-1-1-1-1	3249	2220	1123	2,197
+ Rodan western wheatgrass	8-8-6-6-5-6	7-7-3-2-1-1	2639	3650	x	3,145
+ Lodorm green needlegrass	8-8-7-4-3-3	7-7-7-6-5-3	x	5482	x	5,482
SDSU yellow alfalfa	6-6-1-1-1-4		6477	13030	2947	7,485
+ Manska pubescent wheatgrass	6-5-3-1-2-2	5-5-1-2-4-3	3891	12632	2745	6,422
+ Fleet meadow brome	5-7-3-1-2-3	4-4-1-1-7-7	4466	7890	3048	5,135
+ AC2 crested wheatgrass	5-5-3-3-3-1	4-3-1-2-4-1	5167	7867	3061	5,365
+ Mankota Russian wildrye	5-6-3-1-1-2	5-4-6-4-9-8	2765	x	2465	2,615
+ Rodan western wheatgrass	5-6-3-1-1-3	7-7-5-6-6-8	7456	x	3219	5,337
+ Lodorm green needlegrass	6-6-3-1-1-1	7-7-7-7-9-8	5112	x	x	
+ Bonilla big bluestem	5-5-4-1-1-2	7-7-8-8-9-9	x	x	x	

	Stand Rating (1=best;9=poorest) Over consecutive years		Clipping Dates/Production			
	Legume	Grass	07/21/09	08/09/11	07/18/12	Avg
Travois alfalfa	5-4-2-2-2-1		4018	3049	1299	2,788
+ Maska pubescent wheatgrass	5-5-4-1-3-3	5-3-1-1-1-1	5006	6271	2055	4,444
+ Fleet meadow brome	5-5-4-1-4-2	5-3-1-1-1-2	3734	4491	1642	3,289
+ AC2 crested wheatgrass	3-6-4-1-2-1	5-3-1-1-2-1	3694	5494	2155	3,781
+ Mankota Russian wildrye	4-4-4-1-2-3	4-3-4-2-3-2	2798	3425	1606	2,610
+ NewHy wheatgrass X	4-4-4-1-4-3	4-3-1-1-2-2	5565	4105	1883	3,851
+ Rush intermediate wheatgrass	4-4-4-1-3-2	6-5-3-2-1-2	4577	6618	2456	4,550
+ Rodan western wheatgrass	6-3-3-1-2-2	8-8-6-7-8-4	3775	x	x	3,775
+ Lodorm green needlegrass	6-3-3-1-4-3	6-8-5-8-7-6	3289	x	x	3,289
+ Goldar bluebunch wheatgrass	6-3-2-1-2-4	6-8-8-8-9-9	x	x	x	
+ **Manifest intermediate wheatgrass	3	2	x	4777	2124	3,450
Eski sainfoin	4-4-7-7-8-9		581	x	x	581
+ Maska pubescent wheatgrass	4-4-4-5-9-9	5-5-6-2-2-1	3324	3317	1852	2,831
+ Fleet meadow brome	4-5-5-5-9-9	4-3-3-1-2-2	2153	1519	939	1,537
+ Rodan western wheatgrass	4-6-4-4-9-8	5-6-6-1-1-1	1731	2295	1264	1,763
+ AC2 crested wheatgrass	4-6-5-4-8-8	5-5-3-1-1-1	3626	2778	x	3,202
+ Lodorm green needlegrass	4-4-5-5-9-9	8-8-7-5-8-8	x	x	x	
+ Bonilla big bluestem	6-6-6-7-8-9	7-7-6-6-4-7	x	3503	1236	2,369
Artillery winterfat + Rodan western wheatgrass	8-8-8-8-9-9	8-8-8-4-3-1	x	x	x	
Natrona fourwing saltbush + Rodan western wheatgrass	8-8-8-8-9-9	8-8-7-3-1-1	x	x	x	
SD Cotton fourwing saltbush + Rodan western wheatgrass	7-8-8-6-8-6	8-8-6-4-1-2	x	x	x	
Immigrant forage kochia + Rodan western wheatgrass	6-8-8-7-7-6	8-8-6-5-1-2	x	x	x	
Delar small burnet + Lodorm green needlegrass	6-8-8-8	7-8-8-8	x	x	x	
Bismarck purple prairieclover + Rodan western wheatgrass	9-9	8-8	Removed and replanted to the species below			
Antelope white prairie clover + Rodan western wheatgrass	8-8	7-7				
American vetch(vns) + Rodan western wheatgrass	9-9	8-8				
Dawn birdsfoot trefoil	6	8				
alsike clover (vns)	7	8				
Kenland red clover	7	8				
**big bluestem, sideoats grama, blue grama, little bluestem, Indian ricegrass			x	x	588	588
**Lutana cicer milkvetch	5		x	x	1273	1,273
**green needlegrass, blue grama, sideoats grama, American vetch, western wheatgrass			x	x	1424	1,424
**Delar small burnet / Lodorm green needlegrass	9	8	x	x	x	

	Stand Rating (1=best;9=poorest) Over consecutive years		Clipping Dates/Production			
	Legume	Grass	07/21/09	08/09/11	07/18/12	Avg
**Trailhead basin wildrye		8	x	x	x	
**western wheatgrass, green needlegrass, blue grama, sideoats grama, white prairieclover, purple prairieclover			x	x	x	

**These plots were replanted 5/14/2009 with species listed

Table BI-2. Forage analysis, Bison Plots - clipped on 7/18/12 (ranked by crude protein)

Species	CP	ADF	NDF	CF	TDN	RFV
cicer milkvetch	14.87	31.46	37.59	25.17	66.68	159.4
alfalfa	11.91	44.10	53.73	35.28	52.27	94.4
alfalfa/Russian wildrye	11.32	41.62	67.67	33.30	55.09	77.6
yellow alfalfa/Russian wildrye	11.06	39.69	49.37	31.75	57.29	109.2
yellow alfalfa	10.29	41.52	51.69	33.21	55.21	101.8
alfalfa/meadow brome	9.10	42.79	63.53	34.23	53.77	81.4
yellow alfalfa/meadow brome	8.68	46.07	64.39	36.85	50.02	76.6
alfalfa/intermediate wheatgrass	8.42	38.27	64.79	30.62	58.92	84.8
alfalfa/wheatgrass X	8.24	39.77	65.24	31.82	57.20	82.6
yellow alfalfa/western wheatgrass	8.07	42.58	56.14	34.06	46.24	81.2
alfalfa/intermediate wheatgrass	7.94	40.31	66.72	32.25	56.58	80.2
alfalfa/pubescent wheatgrass	7.81	39.18	65.52	31.34	57.88	82.9
alfalfa/crested wheatgrass	7.43	38.40	64.33	30.72	58.77	85.3
yellow alfalfa/pubescent wheatgrass	7.35	39.88	65.89	31.90	57.08	81.7
cicer milkvetch/meadow bromegrass	6.89	44.55	65.63	35.64	51.75	76.8
yellow alfalfa/crested wheatgrass	6.54	42.30	64.48	33.84	54.32	80.7
sainfoin/meadow brome	6.13	47.00	68.17	37.60	48.96	71.4
cicer milkvetch/pubescent wheatgrass	6.03	39.40	67.81	31.52	57.63	79.9
sainfoin/big bluestem	5.39	44.08	68.62	35.27	52.29	74.0
green needlegrass, blue grama, sideoats grama, American vetch, western wheatgrass	5.07	41.44	67.90	33.15	55.30	77.6
big bluestem,sideoats grama, blue grama, little bluestem, Indian ricegrass	4.90	44.96	71.91	35.97	51.28	69.7
sainfoin/pubescent wheatgrass	4.57	44.29	70.26	35.43	52.05	72.0

CONSERVATION FIELD TRIALS: TECHNICAL REPORT 2011-2012

Number and Title: NDPMC-F-0902-WL (Grass/Legume/Forb Demonstration, Wing, North Dakota)

Objective: Demonstrate different species of grass, forbs, and legumes that can be planted for pasture, hayland, and wildlife benefits.

Date Seeded: May 12, 2009

Cooperators: Ducks Unlimited, Inc.

Methods and Materials: There are 16 plots of various grasses, legumes, forbs, and a forb/legume mixture. The plots were roto-tilled and roller-packed prior to seeding with a 5.5-foot plot drill. The drill consisted of a cone-seeder attachment for each opener so individual rows were metered separately. Plot size is 5.5 feet wide and 57 feet long with 8 rows/plot. There are 11-foot borders separating each group of plots. The four groups are 1) warm-season native grasses; 2) cool-season native grasses; 3) cool-season introduced grasses; and 4) forbs and legumes. See Table WI-1 for a list of entries. There is a minimum 20-foot border around the entire planting. The border areas were seeded to Bad River blue grama.

Site Information: The plots run east to west perpendicular to Highway 14, approximately 20 miles north of Wing, North Dakota, in Sheridan County. The site was previously in cropland, and seeded to a grassland mix in 2007. The area to be seeded to plots was roto-tilled in April 2009. The soils are Barnes complex silt loam with abundant rocks. It is prairie pothole glacial till typical of the area. The plot planting site is level. The property is known as the Coteau Ranch and is owned and operated by Ducks Unlimited, Inc.

Results and Discussion:

2009: Above average rainfall was received in April and May, and the plots picked up good rainfall events throughout the growing season. The plots were evaluated July 22, 2009. The primary weed species was green foxtail, and was quite thick and uniform throughout the plots. The grass species were slowly establishing. Rows were not visible and the existing vegetation (foxtail) had to be sorted through to find the grass. Grasses were two to four inches tall. Introduced grasses were taller and more frequent. The legumes were 8-10 inches tall and had better stands than either the grasses or the forbs. The plots and borders were mowed for weed control during late July.

2010: Good rainfall again this year. Primary weed is green foxtail (pigeongrass), some marehail. Plots were mowed once in mid-summer for weed control. Notes were taken on July 1, 2010. Warm-season grasses are off to a slow start. The big bluestem and switchgrass had visible rows. Canada wildrye and slender wheatgrass are doing well, as would be expected. Meadow bromegrass and hybrid wheatgrass have very good stands. The sainfoin and cicer milkvetch are slow to establish. The yellow-blossom and purple-blossom alfalfa varieties have excellent stands.

2011: No evaluation completed in 2011.

2012: The plots were evaluated for stand, vigor, and weed competition on July 12, 2012. The results are shown in Table WI-1. Many species have shown considerable stand improvement after a very wet 2011 growing season. Pigeongrass is no longer a weed concern. Most invaders were alfalfa and wheatgrasses. Mostly 100% stand loss in the sainfoin and Travois alfalfa plots. Side oats grama much improved from previous years. The cicer milkvetch looks good but is half invaded with Maximilian sunflower.

Table WI-1. Ducks Unlimited Coteau Ranch Demonstration Site (Individual plot size is 5.5' x 57')

Common Name/Variety	Stand and Vigor Rating		Ratings: 1=best; 9=poorest	
	2010	2012	Weeds	Remarks - 2010; 2012
NATIVE, WARM-SEASON GRASSES				
Sideoats grama/Pierre	8	5	5	no rows visible; much improved
Little bluestem/Badlands	8	4	5	no rows visible
Switchgrass/Dacotah	6	3	4	rows in middle; good stand
Big bluestem/Bison	6	1	2	rows in middle; excellent stand
NATIVE, COOL-SEASON GRASSES				
Western wheatgrass/Rodan	5	2	2	nice stand
Canada wildrye/Mandan	3	2	3	good seed production
Green needlegrass/Lodorm	8	4	6	seed already shattered
Slender wheatgrass/Pryor	2	3	6	heading
INTRODUCED, COOL-SEASON GRASSES				
Intermediate wheatgrass/Manifest	4	2	2	heading
Tall wheatgrass/Alkar	4	1	2	
Meadow bromegrass/Fleet	2	1	1	heading; solid stand
Hybrid wheatgrass/NewHy	2	2	4	heading; good stand
FORBS AND LEGUMES				
*Native mix	6	4	6	mostly max/stiff; mostly max
Cicer milkvetch	5	3	5	1/2 maximilian sunflower
Alfafa, yellow-blossom/B.Smith	2	3	5	95% purple; 90% purple
Sainfoin/Eski	7	9	9	in bloom; none found
Alfalfa/Travois	2	9	9	50% bloom; none found

*Native mix is purple prairieclover/Bismarck, white prairieclover/Antelope, Maximilian sunflower/Medicine Creek, stiff sunflower/Bismarck, and narrow-leaved purple coneflower/Bismarck.

CONSERVATION FIELD TRIALS: TECHNICAL REPORT 2011-2012

Number and Title: SDPMC-F-12-1202-PA (Aurora County Conservation District Grass/Legume/Forb Demonstration)

Objective: Establish a multi-species planting that will be utilized for community educational purposes training to demonstrate performance and utilization potential for conservation needs in the area.

Date Seeded: May 15, 2012

Cooperators: Plankinton, SD NRCS, Aurora County Conservation District, SDSU Extension Service, and Millborn Seeds.

Site Information: Along the south side of old Hwy 16 on the west edge of Plankinton, SD, just west of the Aurora County shop and Conservation District Building. The soils are Houdek-Dudley complex loam/silt loam, moderately drained, mostly level with clay-loam sub-layers. There is evidence of a pre-existing narrow driveway that was covered by a shallow layer of gravel, running east-west across the site. The seeding was done with the plot drill into soils that were left untilled (they were tilled early the previous year followed by chemical weed control the rest of the 2011 growing season). Some spots in the site had soils that were hard for the drill to penetrate, and those areas were hand raked to get adequate seed to soil contact. Figure PL-1 indicates the plot layout of warm and cool-season, native and introduced grasses, legumes and forbs that were established in 2012. Forty separate plots were established, with some species seeded as monocultures and others included in mixes. Species included in the mixes are shown in Table PL-1.

Methods and Materials: There are forty 11-ft x 38-ft plots of individual grasses, and grass/legume mixes with a 16-ft blue grama border in this planting (see Figure PL-1). There is an additional acreage for woody species to be planted on the south side of these plots. Total area of all herbaceous plantings is approximately three acres. The plots for this planting were tilled and chemical fallowed in 2011. They were again treated with glyphosate in the spring of 2012, prior to seeding with the PMC plot drill. There was no tillage done before seeding the plots. The blue grama border was seeded at a later date and that ground was tilled prior to seeding.

Figure PL-1. Plot layout of Grass/Legume/Forb Demonstration at Plankinton, South Dakota (11-ft x 38-ft plots)

16' Bad River blue grama border				
16' Bad River blue grama border	1	Kootenai timothy	21	Forb Mix #3
	2	Latar orchardgrass	22	Forb Mix #1
	3	Fawn tall fescue	23	SD common alfalfa (purple)
	4	AC Saltlander quack X bluebunch	24	MN Native Canada milkvetch
	5	Fleet meadow brome	25	VNS (medium) red clover
	6	Omaha Virginia wildrye	26	Warm Season Mix
	7	Mankota Russian wildrye	27	Tomahawk Indiangrass
	8	Oahe intermediate wheatgrass	28	Bounty big bluestem
	9	Revenue slender wheatgrass	29	Sunnyview big bluestem
	10	Alkar tall wheatgrass	30	Sunburst switchgrass
	11	Lodorm green needlegrass	31	Rodan western wheatgrass
	12	Bonilla big bluestem	32	Manska pubescent wheatgrass
	13	Itasca little bluestem	33	Manifest intermediate wheatgrass
	14	Forestburg switchgrass	34	Mandan Canada wildrye
	15	Pierre sideoats grama	35	PMC Virginia wildrye
	16	VNS white clover	36	Prairieland Altai wildrye
	17	Lutana cicer milkvetch	37	NewHy quack X bluebunch
	18	Don yellow alfalfa	38	Garrison creeping foxtail
	19	Forb Mix #2	39	Pennlate orchardgrass
	20	Cool Season Mix	40	Palaton reed canarygrass
16' Bad River blue grama border				

Tree Plots

Table PL-1. Mixture components

Common Name	Variety	Common Name	Variety
Warm-Season Mixes		Forb Mix-1	
big bluestem	Bonilla	purple prairieclover	Bismarck
Indiangrass	Holt	white prairieclover	Antelope
switchgrass	Forestburg	yellow coneflower	
little bluestem	Itasca	purple coneflower	
sideoats grama	Pierre	black-eyed susan	
Cool-Season Mix		Forb Mix -2	
meadow brome	Fleet	Illinois bundleflower	
pubescent wheatgrass	Manska	partridge pea	
cicer milkvetch	Lutana	blanketflower	
Forb Mix-3		bergamot	
Maximilian sunflower		blue flax	
stiff sunflower		western yarrow	

Results and Discussion

2012: Plots were evaluated for stand on 7/23/12. Stand ratings and comments are included in Table PL-2. This area experienced a severe drought in 2012, and rainfall was extremely limited from late spring throughout the entire growing season. There was adequate stored soil moisture for most species to germinate and establish well. The timothy, big bluestem, green needlegrass, and several forbs displayed the poorest emergence at this evaluation date. Weeds (pigweed and foxtail) were becoming an issue in several plots, especially the forb mixes on the western side of the site. Weeds were clipped prior to this evaluation, and it was recommended that (other than the forbs plots) they be clipped shorter to keep them from going to seed. There was no evidence of blue grama germination in the borders. The borders were seeded at a later date than the individual plots, and were planted into cultivated soil. For those reasons, it was apparent there was no longer sufficient soil moisture available for good germination, and/or seed may have been planted too deeply in the looser soil.

Table PL-2. Stand evaluation of grass/legume/forb demonstration at Plankinton, South Dakota.

Plot #	Common Name	Variety	Stand Rating	Comments	
1	timothy	Fleet	9	Plots were very dry and very weedy w/pigweed and some yellow/green foxtail.	
2	orchardgrass	Latar	4		
3	tall fescue	Fawn	3		
4	quack x bluebunch	AC Saltlander	2		
5	meadow brome	Fleet	2	some diseased leaves	
6	Virginia wildrye	Omaha	4	Recommended clipping weeds shorter and coming back with an application of Banvel in late May 2013 to control weeds in grasses.	
7	Russian wildrye	Mankota	2		
8	intermediate wheatgrass	Oahe	2		
9	slender wheatgrass	Revenue	3		
10	tall wheatgrass	Alkar	2		
11	green needlegrass	Lodorm	5		
12	big bluestem	Bonilla	4		
13	little bluestem	Itasca	5		
14	switchgrass	Forestburg	5		
15	sideoats grama	Pierre	3		
16	white clover	VNS	4		
17	cicer milkvetch	Lutana	5		
18	yellow alfalfa	Don	5		
19	Forb Mix #2		3		
20	Cool-Season Mix		3		
21	Forb Mix #3		9		
22	Forb Mix #1		3		Some seedlings dried out!
23	alfalfa (purple)	SD Common	3		
24	Canada milkvetch	MN Native	6		
25	red clover	VNS(medium)	4		
26	Warm-Season Mix		4		
27	Indiangrass	Tomahawk	4		
28	big bluestem	Bounty	5		
29	big bluestem	Sunnyview	8		
30	switchgrass	Sunburst	5		
31	western wheatgrass	Rodan	4	Some seedlings dried out!	
32	pubescent wheatgrass	Manska	3		
33	intermediate wheatgrass	Manifest	3		
34	Canada wildrye	Mandan	3		
35	Virginia wildrye	PMC	3		
36	Altai wildrye	Prairieland	3		
37	quack X bluebunch	NewHy	2		
38	creeping foxtail	Garrison	5	Some seedlings dried out!	
39	orchardgrass	Pennlate	2		
40	reed canarygrass	Palaton	4		
Borders	blue grama	Bad River	9	planted late - poor	

CONSERVATION FIELD TRIALS: TECHNICAL REPORT 2011-2012

Number and Title: NDPMC-F-1103-PA Sully County Conservation District Grasses and Forbs Demonstration

Objective: Provide a living demonstration site to evaluate the forage potential of different grass and forb species

Date Seeded: June 7, 2011

Cooperators: Sully County Conservation District and Fair Board

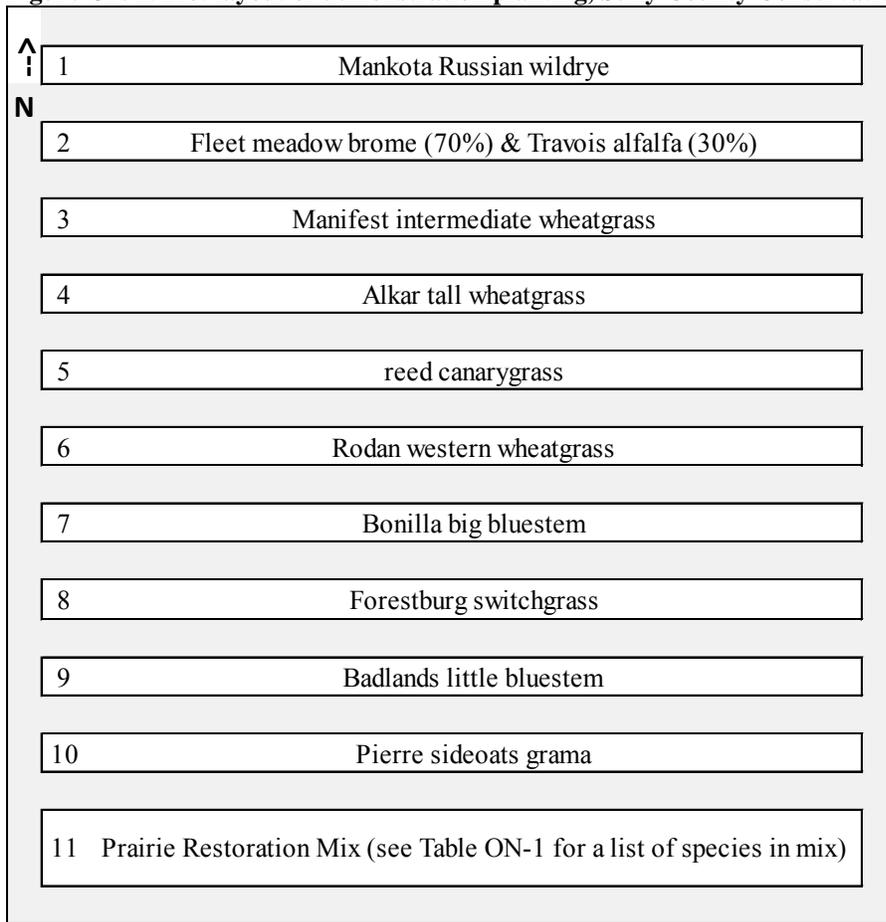
Methods and Materials: This planting includes 9 single species grass plots, one grass-legume plot, and one prairie restoration plot. The plots were tilled and roller-packed prior to seeding with the PMC 5.5-foot plot drill. The drill consisted of a cone-seeder attachment for each opener, so individual rows were metered separately. Individual plots are 11 feet wide and 20 feet long with 16 rows per plot. The prairie restoration plot is 20 feet wide and 20 feet long with 32 rows seeded. There is a 5.5-foot blue grama border between each plot and a minimum 10-foot border around the entire planting. The border areas were seeded to Bad River blue grama. All species were seeded at 1½ times the recommended seeding rates.

Site Information: The planting is located on the eastern end of the Sully County Conservation District property at the eastern edge of the city of Onida, SD. It is bordered by tree windbreaks on the east and south. It is adjacent to the county fairgrounds which borders this site on the north. The site was previously in grass until the spring /summer of 2010, when it was chemically fallowed with glyphosate to kill existing vegetation. In the fall of 2010 the chemical fallowed area was tilled in preparation for seeding in the spring of 2011. The soils are Onita silt loam complex and the site is level.

Table ON-1. List of species included in the prairie restoration mix in the demonstration planting, Sully County SCD, South Dakota

Grasses Included in the Prairie Restoration Mix	Forbs/Wildflowers Included in the Prairie Restoration Mix
Bad River Ecotype blue grama	Echinacea
'Bonilla' big bluestem	purple prairieclover
'Lodorm' green needlegrass	blanketflower
'Tomahawk' Indiangrass	yellow coneflower
Badlands Ecotype little bluestem	leadplant
needleandthread	shell-leaved penstemon
prairie junegrass	stiff sunflower
prairie sandreed	yarrow
'Pierre' sideoats grama	dotted gayfeather
'Mandan' Canada wildrye	Canada milkvetch
'Rodan' western wheatgrass	black-eyed susan
	false sunflower
	Maximilian sunflower

Figure ON-1. Plot layout of demonstration planting, Sully County Conservation District, SD



Results and Discussion:

2011: Above average rainfall and a cool spring delayed planting until June 7. The soils were still saturated at planting and a few plots were almost too wet to plant. Heavy rainfall events during the summer of 2011 resulted in flooding on portions of the plots on the northern end of the site. Much of the flooding was a result of some minor diking on the driveway on the north side of the site. This concern was later remediated by the District and is no longer an issue. No further evaluation was done in 2011. A spring, 2012 evaluation will be completed to determine which species might need to be replanted as a result of the flooding.

2012: The site was evaluated by the District Conservationist on 4/1/12. Portions of plots 1, 2, and 3 were dead and bare as a result of 2011 flooding. Some of the blue grama border on the northern part of the site was also dead as a result of flooding. The bare areas of plots 1, 2, and 3 were tilled, packed and reseeded to original species and rates on May 16. The plots were evaluated again on July 23. Most species that were not impacted by flooding appeared to be establishing well. The big and little bluestem plots were very thin and weedy, and the brome/alfalfa plot that was reseeded had very poor emergence and was very weedy. The prairie restoration mix was well established and relatively weed free. Some weeding was done during this evaluation, and District personnel will spray the grass plots that have the most serious broadleaf weed issues.

Table ON-2. Evaluation of demonstration plots on 7/23/2012 at Sully County SCD, South Dakota

N	Onida, SD Grass Plots Evaluation (1=best; 9=poorest)	7/23/2012		
		*Stand	**Weeds	comments
1	Mankota Russian wildrye	2	3	
2	Fleet meadow brome-70% & Travois Alfalfa-30%	7	8	Flood damaged
3	Manifest intermediate wheatgrass	2	1	
4	Alkar tall wheatgrass	1	1	considerable lodging
5	Reed canarygrass	1	1	
6	Rodan western wheatgrass	1	1	
7	Bonilla big bluestem	4	4	
8	Forestburg switchgrass	3	3	
9	Badlands little bluestem	5	5	
10	Pierre sideoats grama	2	1	
11	Prairie Restoration Mix	1	1	

*Stand: 1=best, 9=poorest

**Weeds: 1=low weed population, 9=high weed population

RELEASES

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
BISMARCK, NORTH DAKOTA

MINNESOTA
AGRICULTURAL EXPERIMENT STATION

NORTH DAKOTA
AGRICULTURAL EXPERIMENT STATION

SOUTH DAKOTA
AGRICULTURAL EXPERIMENT STATION

NOTICE OF RELEASE OF BOUNTY GERmplasm BIG BLUESTEM

The US Department of Agriculture; Natural Resources Conservation Service; Minnesota Agricultural Experiment Station; North Dakota Agricultural Experiment Station; and the South Dakota Agricultural Experiment Station announce the naming and release of a seed propagated selected class germplasm of big bluestem, *Andropogon gerardii* (Vitman). This selected class pre-varietal release will be known as Bounty Germplasm big bluestem.

Bounty Germplasm big bluestem has been developed from an original composite of 82 vegetatively selected plants from 40 different counties in Minnesota, and 9 counties in eastern South Dakota (Figure 1, Table 1). NRCS accession number 9063122 was assigned to this selection. Bounty Germplasm big bluestem will fill the need for a more genetically diverse improved release that is broadly adapted to Minnesota and the surrounding region. This release is expected to perform well wherever big bluestem is recommended in Minnesota, the eastern Dakotas, and surrounding regions in the Northern Great Plains and Upper Midwest.

Bounty Germplasm big bluestem is released for conservation use in native plantings with the primary objective of ecological revegetation, wildlife habitat, and forage production. Variation in maturity, plant size, leafiness, color, and potential seed production were documented in the breeder seed field. Bounty Germplasm has a high level of species diversity and forage quality, and is expected to perform well over a broad area throughout Minnesota, the eastern Dakotas, and bordering states. Seed sources within the composite are local to specific planting sites. Plants originating greater distances from the planting site add genetic diversity within the species, for improved long-term stability and broader area of adaptation (Harris et al 2006). Generation 0 (breeder) seed was harvested from the clonally propagated progeny of selected plants that had promise of genetic superiority. Individual seed maturity differences may range two to three weeks.

Collection Site Information: Vegetative collections of 326 accessions of naturally occurring big bluestem were made by NRCS field personnel in Minnesota, and in eastern South Dakota in the fall of 1985. This area covers parts of three land resource regions including (F) Northern Plains Spring Wheat Region, (K) Northern Lake States Forest and Forage Region, and the (M) Central Feed Grains and Livestock Region. Average annual rainfall ranges from approximately 20-34 inches with a freeze-free period ranging from 95 days in northern Minnesota to 150 days near the Iowa border (USDA 2006).

Accession numbers were assigned to each collection and the vegetative crown pieces were divided and potted into small containers in the spring of 1986.

Description: Big bluestem is a tall, stout, perennial, warm-season, native grass with stiff, erect culms. Leaf blades have prominent midribs, flattened and keeled sheaths, and fringed membranous ligules below the collar. Rachis internodes are thinly to rather densely hairy (Sedivec and Barker, no date). It is often called “turkeyfoot” because the seed heads usually have 3 spikelets. Bounty varies in height from 4 to 6 feet tall, and is shorter in more northern climates. The abundant forage is one of the most palatable grasses. Its deep, spreading root system makes it an excellent erosion control plant. It can form a sod, and has short, scaly rhizomes. It performs best on fertile, well drained soils, but is also adapted to sites with shallow depth, low pH, and low fertility. Big bluestem is the dominant grass species of the Midwestern tall grass prairie. It provides excellent wildlife habitat and food sources. It is native to most of the United States and Canada except for the far western areas (USDA 2011). Big bluestem is a host plant to many butterflies and other pollinator species (Tallamy 2009). It is becoming more popular as a landscaping plant.

Method of Selection: The evaluation nursery was located at the USDA-Agricultural Research Service, Northern Great Plains Research Laboratory at Mandan, North Dakota. More than 4,000 plants were established in the nursery from May 27 to June 13, 1986 (USDA 1990-1991). The experimental design was a randomized complete block with four replications. Individual subplots of three cloned big bluestem plants were randomly planted within each block. Individual blocks contained 1,071 plants or 357 three-plant subplots. Six different varieties of big bluestem were included in the nursery as standards of comparison, including Champ, Pawnee, Rountree, Bonilla, Bison, and Sunnyview.

Data collected from 1987-1990 included survival, vigor, disease, size, leafiness, and forage quality. These plants displayed 97 percent survival the first year. Approximately 41 percent of those surviving plants were rated as having low vigor, and 2 percent as very high vigor. A majority of the plants were rated as having good vigor. The most vigorous plants had a broader crown and were larger than plants having low vigor. Disease problems consisted mostly of leaf and stem rust.

Evaluations in 1989 and 1990 included gridding the nursery into 4 x 6 plant plots. Two superior plants were selected in each 24 plant grid. Each was representative of an early and a late-maturing population. Selection factors included leafiness, disease resistance, seed production potential, and vigor. In 1990, selected plants were rated for phenology and separated into early and late-maturing populations. Based primarily on forage quality parameters, 94 out of 177 (53%) of the early-maturing accessions were selected for further study. Generally, these plants had finer leaf and stem material, and were smaller and less robust than the later-maturing population. The selected plants were vegetatively established into a polycross block in 1991. Additional evaluation and some roguing were completed prior to seed harvest. Leaf, stem, and culm samples were collected from the remaining 82 plants at first flowering. These samples were analyzed for crude protein, acid detergent fiber, neutral detergent fiber, and relative feed value by the Northern Great Plains Research Laboratory at Mandan, North Dakota. Crude protein ranged from 6 to 10 percent and Relative Feed Values varied from 62 to 77 percent (Table 2). The standards of comparison were also sampled for forage quality. The most northern origin big bluestem, Bison averaged 7% crude protein compared to Rountree (IA) which averaged 4% (Figure 2).

The selected big bluestem plants comprising Bounty Germplasm averaged slightly more than 7% crude protein, higher than the population average of 6%. The average relative feed value increased from 67% for the base population to 9% for the selected plants (Figure 4). Seed harvested from the selected early-maturing population was seeded in the increase field at the Bismarck Plant Materials Center in June 2010. This seed (Bounty Germplasm) from 82 superior plants contains a broad representation originating from 40 Minnesota and 9 South Dakota counties (Figure 1).

Field Measurements: On July 26, 2011, data was collected from the foundation field that was planted in 2010. To document the diversity within the population, the field was divided into 5 representative sample areas. Ten plants were systematically flagged for sampling in each of the 5 sample areas. Data from those samples indicated that individual plant height varied from 3.75 to 6 feet. Sample means were more uniform from 4.9 to 5.45 feet. Width was less variable and most of the two-year-old plants were nearly a half foot wide. Most plants rated best for leafiness, and none of the sample means rated more than 1.4 (1=best; 3=poor). Phenology varied up to three weeks from medium boot (12%) to medium flower (2%). Most of the plants were late boot (44%) to early flower (42%), (Table 3).

Ecological Considerations: Big bluestem is relatively easy to establish and competes well with other species. It has been known to establish from seed in smooth brome grass stands over time, especially if the brome grass is mowed or grazed during critical periods, allowing the big bluestem to gain a foothold. Big bluestem is a native species with many desirable traits. Encroachment off site would not generally be considered negative. Seed is spread by birds and other animals, as well as natural events such as flooding and wind storms. Vegetative spread is minimal. Big bluestem is considered non-invasive and is easy to control as a landscape plant.

Conservation Use: The conservation uses of Bounty Germplasm big bluestem are many, and include conservation cover, erosion control, pasture and hayland, wildlife habitat, prairie revegetation, rangeland seeding, and landscaping.

Potential Area of Adaptation: Bounty Germplasm big bluestem is expected to perform well throughout Minnesota and the eastern Dakotas. It has not been tested in the surrounding regions of the Northern Great Plains and Upper Midwest, but should perform well in those areas.

Availability of Plant Materials: Breeder seed (Generation 0) will be maintained by the Bismarck Plant Materials Center. Foundation seed will be grown by the Bismarck PMC, and distributed through North Dakota State University Foundation Seed Stocks as a selected class (green tag) germplasm.

References:

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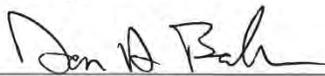
Prepared by: Wayne Markegard, Plant Materials Specialist, USDA-NRCS, P. O. Box 1458, Bismarck, North Dakota 58502; Wayne L. Duckwitz, Plant Materials Center Manager, and Nancy K. Jensen, Agronomist, USDA-NRCS Plant Materials Center, 3308 University Drive, Bismarck, North Dakota 58504; Dwight Tober, retired, USDA-NRCS.

Approvals for the release of Bounty Germplasm big bluestem, *Andropogon gerardii* (Vitman):

for 

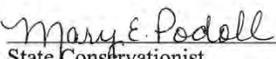
Director, Ecological Sciences Division
United States Department of Agriculture
Natural Resources Conservation Service
Washington, D.C.

9-28-2012
Date



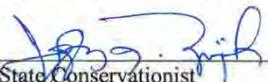
State Conservationist
United States Department of Agriculture
Natural Resources Conservation Service
Saint Paul, Minnesota

5-14-12
Date



State Conservationist
United States Department of Agriculture
Natural Resources Conservation Service
Bismarck, North Dakota

April 25, 2012
Date



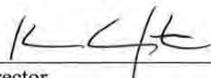
State Conservationist
United States Department of Agriculture
Natural Resources Conservation Service
Huron, South Dakota

June 7, 2012
Date



Director
University of Minnesota
Agricultural Experiment Station
St. Paul, Minnesota

5/14/12
Date



Director
North Dakota State University
Agricultural Experiment Station
Fargo, North Dakota

7/5/12
Date



Director
South Dakota State University
Agricultural Experiment Station
Brookings, South Dakota

6/25/12
Date

Table 1. Collection site information for 82 selected (early maturing) plants from Minnesota and South Dakota.

Accession No.	State	from Minnesota and South Dakota	Site	Collector	Accession No.	State	County	Site	Collector
9053432	MN	Anoka	SA	T.R. Fredbo	9053260	MN	Polk	SA	R.L. Parent
9053342	MN	Becker	N/A	L. R. Johnson	9053261	MN	Polk	Si	R.L. Parent
9053342	MN	Becker	N/A	L. R. Johnson	9053261	MN	Polk	Si	R.L. Parent
9053241	MN	Beltrami	N/A	R.E. Rundell	9053263	MN	Polk	N/A	M.W.Nienaber
9053257	MN	Beltrami	Non-pastured	D. K. Krystosek	9053383	MN	Pope	O	D.L. Copeland
9053329	MN	Benton	N/A	K.E. Adelman	9053430	MN	Ramsey	SA	T.R. Fredbo
9053331	MN	Benton	N/A	K.E. Adelman	9053468	MN	Redwood	N/A	C.M. Bower
9053408	MN	Blue Earth	N/A	M.G. Oja	9053371	MN	Renville	N/A	D.G. Bidinge
9053471	MN	Brown	N/A	L.H. Schmidt	9053373	MN	Renville	N/A	D.G. Bidinge
9053290	MN	Carlton	N/A	D.Benrud	9053499	MN	Rock	Overflow	D.L. Briggs
9053419	MN	Carver	10 D	S.P. Wendland	9053245	MN	Roseau	N/A	D.A. Johnson
9053296	MN	Cass	N/A	W.R. Pehling	9053322	MN	Sherburne	N/A	W.O. Harju
9053300	MN	Cass	N/A	W.R. Pehling	9053374	MN	Swift	Subirrigated	L.L.Popma
9053265	MN	Clearwater	N/A	I.L. Johnson	9053375	MN	Swift	Wetland	L.L. Popma
9053461	MN	Cottonwood	Wetland	G.D. Moreau	9053375	MN	Swift	Wetland	L.L. Popma
9053294	MN	Crow Wing	N/A	M.J. Reetz	9053336	MN	Todd	N/A	R.E. Krause
9053332	MN	Douglas	N/A	C.W. Emmert	9053337	MN	Todd	N/A	R.E. Krause
9053479	MN	Filmore	N/A	K.R. Rismeyer	9053361	MN	Traverse	Si	G.D. Berg
9053278	MN	Itasca	N/A	T.J. Weber	9053449	MN	Wabasha	N/A	L.J. Svien
9053251	MN	Lake of the Woods	20%	J.E. Berg	9053449	MN	Wabasha	N/A	L.J. Svien
9053475	MN	Lincoln	Overflow	J.N. Behnke	9053426	MN	Washington	N/A	G.L. Brown
9053239	MN	Marshall	CY	T.J. Steger	9053338	MN	Wilkin	SB	G.J. Kushnerek
9053304	MN	Morrison	N/A	S.G. Wilson	9053326	MN	Wright	25 D	J.M. Wiltsey
9053304	MN	Morrison	N/A	S.G. Wilson	9053327	MN	Wright	25 D	J.M. Wiltsey
9053485	MN	Murray	Si	P.C. Weikle	9053327	MN	Wright	25 D	J.M. Wiltsey
9053485	MN	Murray	Si	P.C. Weikle	9053328	MN	Wright	25 D	J.M. Wiltsey
9053231	MN	Norman	Sb	F.J. Kollmann	9053366	MN	Yellow Medicine	Silty	A.H. Lynne
9053232	MN	Norman	Sa	F.J. Kollmann	9053512	SD	Clark	Si	E. Henderson
9053232	MN	Norman	Sa	F.J. Kollmann	9053545	SD	Day	Silty	L.P. Noeske
9053232	MN	Norman	Sa	F.J. Kollmann	9053545	SD	Day	Silty	L.P. Noeske
9005673	MN	Olmsted	N/A	N/A	9053556	SD	Deuel	Si	H.L. Minnick
9005674	MN	Olmsted	Lime Rock	N/A	9053556	SD	Deuel	Si	H.L. Minnick
9053347	MN	Ottertail	Si	J.A. Schmidt	9053537	SD	Lincoln	Thin Upland	R.W. Lehman
9053352	MN	Ottertail	Sy	C.J. Neseth, JR.	9053519	SD	Marshall	Overflow	L.P. Duerre
9053234	MN	Pennington	SA	J.E. Schmid	9053519	SD	Marshall	Overflow	L.P. Duerre
9053234	MN	Pennington	SA	J.E. Schmid	9053520	SD	Marshall	Silty	L.P. Duerre
ND-755	MN	Polk	Ditch	R.J. Feldt	9053552	SD	Miner	Sb	C.D. Welbon
ND-755	MN	Polk	Ditch	R.J. Feldt	9053554	SD	Moody	Subirrigated	D.J. Larson
ND-755	MN	Polk	Ditch	R.J. Feldt	9053554	SD	Moody	Subirrigated	D.J. Larson
9053259	MN	Polk	SB	R.L. Parent	9053523	SD	Roberts	Limy Sub.	S.C. Caruana
9053260	MN	Polk	SA	R.L. Parent	9053521	SD	Turner	Si	J.W. Rezek

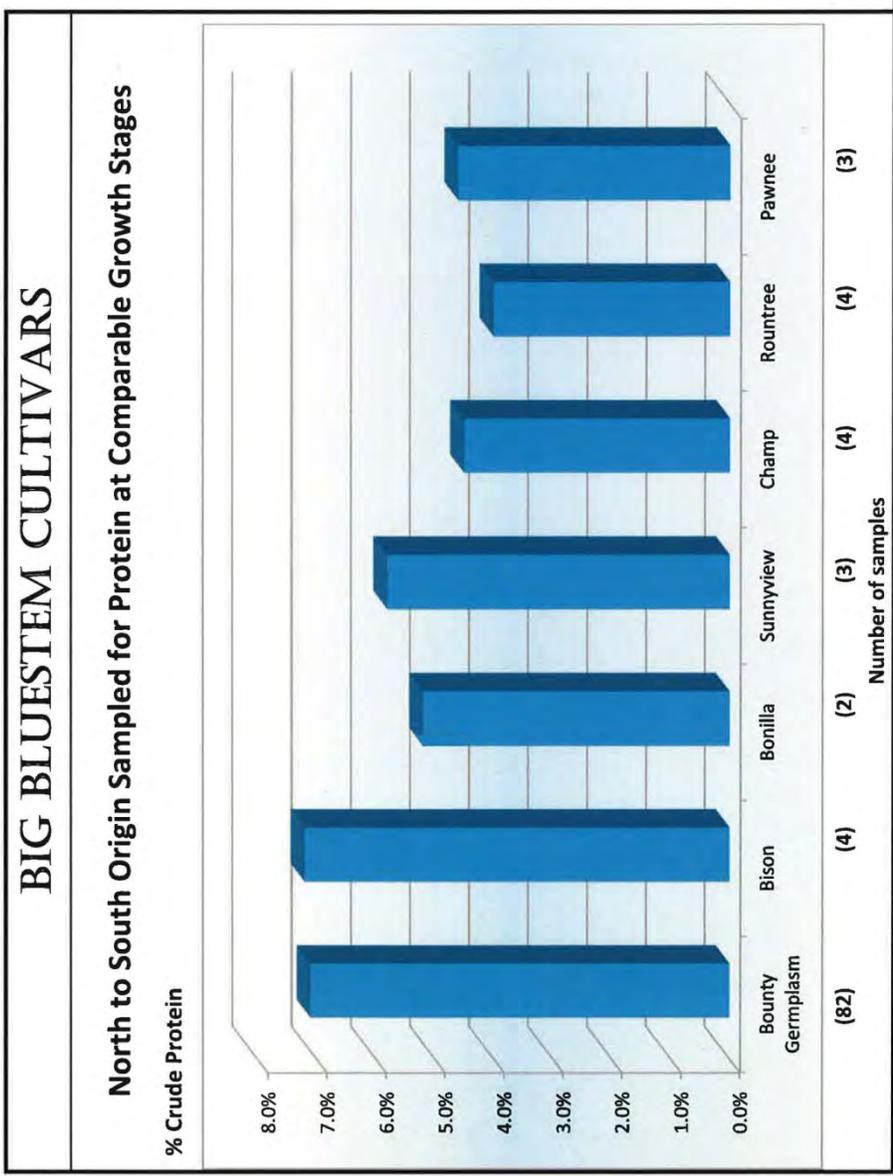
Accession No.	% Dry Matter	% Crude Protein	% Acid Detergent Fiber	% Neutral Detergent Fiber	Relative Feed Value	Accession No.	% Dry Matter	% Crude Protein	% Acid Detergent Fiber	% Neutral Detergent Fiber	Relative Feed Value
9053432	96.43	6.56	43.96	73.31	69	9053260	97.07	7.03	45.84	73.08	68
9053342	96.68	7.37	44.62	73.75	68	9053261	96.48	7.48	46.21	73.69	67
9053342	96.46	7.06	46.2	74.9	66	9053261	96.86	6.15	45.04	72.89	69
9053241	96.79	7.23	43.63	72.21	71	9053263	97.19	7.23	44.79	73.05	69
9053257	96.59	8.46	44.91	72.86	69	9053383	96.61	6.91	43.89	73.06	70
9053329	96.14	7.99	44.07	72.97	70	9053430	96.55	7.14	47.98	75.65	63
9053331	96.61	6.54	43.57	73.05	70	9053468	96.82	7.52	43.56	72.26	71
9053408	97.22	6.09	45.99	74.39	66	9053371	96.71	6.24	44.3	74.78	67
9053471	96.46	5.8	43.2	73.69	70	9053373	96.75	5.96	45.71	73.85	67
9053290	96.44	6.89	45.71	74.62	66	9053499	96.6	6.41	44.58	73.44	69
9053419	96.94	7.18	43.05	71.84	72	9053245	96.68	7.94	43.45	71.01	72
9053296	96.69	8.63	44.66	73.37	69	9053322	96.65	7.33	40.13	69.27	77
9053300	96.63	9.59	43.09	70.74	73	9053374	96.68	7.65	44.58	72.12	70
9053265	96.93	7.35	48.32	74.69	64	9053375	96.49	7.54	45.47	73.83	67
9053461	96.13	6.58	43.71	73.24	70	9053375	96.74	7.71	43.15	70.82	73
9053294	96.49	6.64	44.69	73.64	68	9053336	96.76	6.28	48.31	75.29	63
9053332	96.58	6.74	44.78	71.88	70	9053337	96.4	8.64	42.55	71.64	72
9053479	96.79	6.03	48.1	75.19	64	9053361	96.5	8.03	42.5	72.7	71
9053278	96.81	8.37	46.46	72.64	67	9053449	96.24	5.9	45.65	75.29	66
9053251	96.52	8.31	45.47	74.12	67	9053449	96.86	7	44.35	73.17	69
9053475	96.33	6.25	45.76	74.35	67	9053426	96.49	8.98	43.18	71.08	72
9053239	96.72	8.35	43.94	71.72	71	9053338	96.43	7.16	43.99	73.03	70
9053304	96.44	7.17	44.68	73.36	69	9053326	97.04	7.91	43.54	71.71	71
9053304	96.46	6.53	46.14	74.53	66	9053327	96.38	6.54	45.53	74.07	67
9053485	96.32	7.68	42.76	71.81	72	9053327	96.51	5.71	46.47	74.79	66
9053485	96.66	8.18	44.74	74.01	68	9053328	97.35	6.19	43.95	70.59	72
9053231	96.72	7.31	46.48	74.84	65	9053366	96.73	6.03	49.19	76.14	62
9053232	96.87	8.37	44.85	72.61	69	9053512	96.26	6.56	44.33	73.7	69
9053232	96.41	6.02	45.49	74.65	67	9053545	96.72	7.62	46.06	73.22	67
9053232	96.65	8.12	43.74	72.28	71	9053545	96.91	5.94	45.7	75.32	66
9005673	96.41	7.46	44.46	73.1	69	9053556	96.82	6.02	45.42	73.68	68
9005674	96.44	5.87	44.75	73.79	68	9053556	96.25	6.15	45.91	74.52	66
9053347	96.73	7.1	45.95	74.6	66	9053537	96.26	6.3	46.72	75.23	65
9053352	96.43	6.85	47.47	75.22	64	9053519	96.94	7.74	43.94	72.78	70
9053234	96.49	7.54	43.04	71.85	72	9053519	96.31	6.66	44.36	74.47	68
9053234	96.61	8.42	42.03	70.55	74	9053520	97.24	8.38	42.04	69.38	75
ND-755	96.74	7.97	43.7	71.4	71	9053552	96.22	6.59	43.08	73.51	70
ND-755	96.55	6.89	47.97	75.7	64	9053554	96.56	5.86	45.15	74.61	67
ND-755	96.58	6.8	45.43	72.5	69	9053554	96.93	6.18	43.82	72.17	71
9053259	96.53	8.25	43.04	73.09	70	9053523	96.73	7.4	44.76	73.87	68
9053260	96.61	6.02	45.41	75.92	66	9053521	96.49	6.59	42.59	71.97	72
Averages for all 82 plants---->							96.62	7.11	44.78	73.29	68.6

Table 3.

Sample Location	Averages			Percent of plants			
	Plant Height (feet)	Plant Width (feet)	Leafiness (1=best; 3=poor)	medium boot	late boot	early flower	medium flower
1	4.900	0.635	1.4		20	70	10
2	5.450	0.550	1.2		60	40	
3	5.100	0.525	1.3	20	20	60	
4	5.250	0.500	1.3	30	50	20	
5	5.025	0.500	1.4	10	70	20	
Total Ave.	5.145	0.542	1.32	12	44	42	2

Five samples of ten plants each were collected throughout the foundation field planting of Bounty Germplasm big bluestem, on June 26, 2011. These were evaluated for plant height, width, leafiness, and phenology.

Figure 2



Feed quality of the selected of 82 plants (Bounty Germplasm) as compared to the early maturing population (177 plants) of big bluestem.

Figure 3

Average Percent Crude Protein

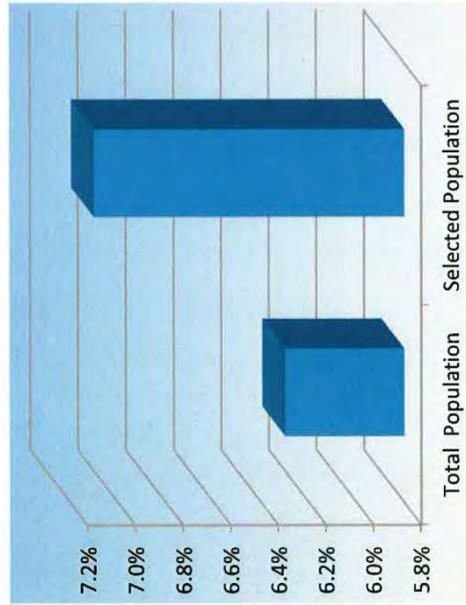
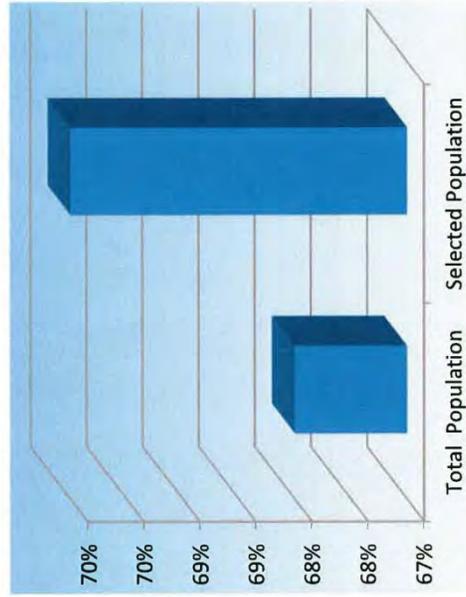


Figure 4

Average Percent Relative Feed Value



SEED PRODUCTION

SEED PRODUCTION RECORD

Accession: 'Nordan'

Name/Species: Crested wheatgrass, *Agropyron desertorum*

Location: Minot Experiment Station

Year of Establishment: 1999

Origin/Source: Selected at USDA, ARS, Mandan, ND

<u>Prod. Year</u>	<u>Seed Class</u>	<u>App./Cert. No.</u>	<u>Seed Lab No.</u>	<u>Acres</u>	<u>Bulk (lbs)</u>			<u>Other</u>					<u>Notes</u>
					<u>Quantity</u>	<u>Purity</u>	<u>Germ.</u>	<u>Dorm.</u>	<u>Inert</u>	<u>Weed</u>	<u>Crop</u>	<u>Test Date</u>	
2000	Common	*	2004975	3	1225	87.25	94	0	12.63	0.04	0.08	1/22/2001	
2001	Foundation	S0113586	2112669	3	523	96.3	91	0	3.66	0.02	0.02	4/29/2002	
2002	Foundation	S0210283	L2204714	3	541	94.05	89	0	5.93	0.02	0	1/6/2003	
2003	Foundation	C54968	L2305433	3	200	91.39	88	0	8.57	0	0.04	1/28/2004	
2004		S0412380	L2409683	3	134	91.42	89	0	8.06	0.44	0.08	3/23/2005	
2005	No harvest												
2006	No harvest												
2007	No harvest												
2008	Needs re-cleaning due to large amounts of ergot					280							
2009	Common*	S0912475	L2912888	3	1145	88.48	92	0	11.45	0.05	0.02	5/27/2010	
			L1009823										
2010	Foundation	C12515	L1010314	3	393	93.29	86	0	6.6	0.04	0.07	5/17/2011	Ergot 0.3%
2011	No harvest												
2012	Removed												

*Seedlot contained quackgrass, failed certification

SEED PRODUCTION RECORD

Accession: 'Bison' (NDG-4, 9005667, PI-477994)

Name/Species: big bluestem, *Andropogon gerardii*

Location: Field E-8

Year of Establishment: 1997

Origin/Source: Oliver County, North Dakota; USDA, ARS, Mandan, North Dakota

Prod. Year	Seed Class	App./Cert.	Seed	Bulk (lbs)							Other	Test Date	Notes
		No.	Lab No.	Acres	Quantity	Purity	Germ.	Dorm.	Inert	Weed	Crop		
1998	Foundation	980067-1	9808345	3.04	248.0	95.60	87	0	4.26	0.14	0	3/24/1999	
1999	Foundation	990863-1	9904487	1.76	279.5	90.13	90	0	9.86	0.01	0	1/26/2000	
1999	Foundation	990863-1	9903569	1.28	165.0	93.62	88	0	6.35	0.03	0	1/12/2000	Plateau
2000	Foundation	201150-1	2007607	3.04	294.0	95.89	90	1	3.95	0.16	0	3/13/2001	
2001	Foundation	S0113839	2107325	3.04	419.0	96.95	86	0	2.98	0.07	0	3/27/2002	
2002	Foundation	S0210299	L2210878	3.04	115.0	88.48	30	49	11.51	0.01	0	4/10/2003	
2003	Foundation	C54832	L2304932	3.04	328.0	93.90	28	57	6.1	0	0	2/3/2004	
2004	Foundation	S0412038	L2411492	3.00	446.0	96.61	55	37	3.38	0.01	0	4/15/2005	
2005	Foundation	S0513080	L2509594	3.00	462.0	96.40	47	42	3.6	0	0	3/20/2006	
2006	Foundation	S0611773	L2609510	3.00	26.0	69.03	47	38	30.95	0.01	0.01	3/28/2007	
2007	Foundation	C69301	L2703199	3.00	724.0	97.63	42	46	2.33	0.03	0.01	12/13/2007	
2008	Foundation	C81842	L2808793	3.00	270.0	95.71	62	26	4.29	0	0	4/16/2009	
2009	Foundation	C92149	L2910722	3.00	335.0	87.73	40	45	12.27	0	0	4/23/2010	
2010	Foundation	C12097	L1008984	2.80	50.0	94.22	61	22	5.62	0.15	0.01	4/21/2011	Ergot 0.23%
2011	Foundation	C21794	L1104759	2.80	399.0	92.34	49	44	7.63	0.03	0	12/12/2012	Ergot 0.1%
2012	Foundation	C26199	L1208309	2.80	269.0	98.06	55	43	1.9	0.04	0	4/23/2013	

SEED PRODUCTION RECORD

Accession: 'Bonilla' (SD-27, PI-315658)

Name/Species: big bluestem, *Andropogon gerardii*

Location: Field D-10

Year of Establishment: 1987

Origin/Source: Morton County; USDA, ARS, Mandan, North Dakota

Prod. Year	Seed Class	App./Cert. No.	Seed Lab No.	Acres	Bulk (lbs)			Germ.	Dorm.	Inert	Weed	Other Crop	Test Date	Notes
					Quantity	Purity								
1988	Foundation	1764	M35857	1.40	320.0	97.04	74	1	2.96	0.00	0.00	3/27/1989		
1989	Foundation	91992	N10095	1.40	159.0	95.33	76	0	4.66	0.00	0.01	12/15/1989		
1990	Foundation	1650	N2322	1.40	115.0	98.07	83	1	1.92	0.00	0.01	1/17/1991		
1991	Foundation	2135	N18291	1.40	118.0	93.76	77	0	6.24	0.00	0.00	1/27/1992		
1992	Foundation	1053-1	P08550	1.42	175.0	92.16	73	0	7.83	0.00	0.00	1/12/1993		
1993	Foundation	3067-1	9303772	1.42	165.0	95.07	72	0	4.93	0.00	0.00	2/28/1994		
1994	Foundation	940232-1	9406903	1.42	276.5	93.34	82	1	6.64	0.00	0.02	1/31/1995		
1995	Foundation	950194-1	9514495	1.42	124.5	97.35	89	0	2.64	0.01	0.00	4/22/1996		
1996	Foundation	960049-1	9609264	1.42	242.0	85.85	78	0	14.14	0.01	0.00	3/18/1997		
1997	Foundation	970037-1	9709197	1.42	180.5	92.18	83	1	7.82	0.00	0.00	3/13/1998		
1998	Foundation	980059-1	9803403	1.42	298.0	97.22	88	1	2.78	0.00	0.00	1/5/1999		
1999	Foundation	990858-1	9910452	1.42	237.5	94.58	87	0	5.42	0.00	0.00	4/27/2000		
2000	Foundation	201151-1	2011941	1.42	168.0	89.14	92	0	10.84	0.01	0.01	5/4/2001		
2001	Foundation	S0113838	2106047	1.42	49.0	92.78	88	0	6.75	0.46	0.01	2/26/2002		
2002	Foundation	S0210303	L2213179	1.42	71.0	95.5	70	16	4.48	0.01	0.01	5/7/2003		
2003	Foundation	C5660	L2311320	1.42	200.0	93.26	73	19	6.74	0.00	0.00	4/22/2004		
2004	Foundation	S0412037	L2413895	1.40	198.0	94.75	79	14	5.25	0.00	0.00	5/6/2005		
2005	Foundation	S0513081	L2513292	1.40	258.0	97.87	72	15	2.13	0.00	0.00	5/4/2006		
2006	minimal harvest	S0611774	no test	1.40	0.0									
2007	Foundation	C70557	L2708118	1.40	242.0	97.66	78	8	2.34	0	0	3/11/2008		
2008	Foundation	C81097	L2806016	1.40	274.0	98.23	84	9	1.76	0	0	2/1/2009		
2009	Foundation	C91516	L2907228	1.40	235.0	96.25	72	18	3.62	0.13	0	3/18/2010		
2010	Foundation	C10993	L1005406	1.40	150.0	96.6	78	9	3.37	0.01	0.01	2/8/2011	Ergot 0.25%	
2011	Foundation	C23752	L1111639	1.50	215.0	94.76	72	6	5.19	0.04	0.01	7/17/2012		
2012	Foundation	C25988	L1207474	1.40	175.0	96.13	69	15	3.86	0.01	0.00	4/9/2013	ergot 0.63%	

SEED PRODUCTION RECORD**Accession:** Bounty Germplasm**Name/Species:** big bluestem; *Andropogon gerardii***Location:** D11**Year of Establishment:** 2010**Origin/Source:** composite; Minnesota

Prod.		App./Cert.	Seed		Bulk (lbs)						Other	
Year	Seed Class	No.	Lab No.	Acres	Quantity	Purity	Germ.	Dorm.	Inert	Weed	Crop	Test Date
2010	Breeder	no harvest										
2011	Breeder		L1110933	0.5	80	93.73	45	41	6.23	0.04	0	4/27/2012
2012	Select	C25253	L1204953	0.5	27	96.52	26	31	3.48	0	0	2/11/2013

SEED PRODUCTION RECORD

Accession: 9082680

Name/Species: fourwing saltbush, *Atriplex canescens*

Location: Field D10df

Year of Establishment:

Origin/Source: Cottonwood, South Dakota

<u>Prod. Year</u>	<u>Seed Class</u>	<u>App./Cert. No.</u>	<u>Seed Lab No.</u>	<u>Acres</u>	<u>Bulk (lbs) Quantity</u>	<u>Purity</u>	<u>Germ.</u>	<u>Dorm.</u>	<u>Inert</u>	<u>Weed</u>	<u>Other Crop</u>	<u>Test Date</u>
2002	breeder		no test		5.5		78(TZ)	0	1.4	0.00	0.00	11/13/2002
2003	breeder				3.5	98.6	46	9(hard)	1.4	0.00	0.00	3/3/2004
2004	breeder		no test		6.0							
2005	breeder		no test	100-ft row	0.5							
2006	breeder		no test		20.0							
2007	breeder	bulked with previous years' crop			5.0							
2008	breeder		no test		20.0							
2009	breeder		no test		32.0							
2010	breeder		no test		7.0							
2011	breeder		L1104382		16.0	96.88	4	67	3.12	0	0	12/28/2011
2012	breeder		no test		9.0							

SEED PRODUCTION RECORD**Accession:** Pierre (SD-251, PI-476980) continued from previous page**Name/Species:** sideoats grama, *Bouteloua curtipendula***Location:** Field E-9**Year of Establishment:** 1977**Origin/Source:** Stanley County; Ft. Pierre, South Dakota

<u>Prod. Year</u>	<u>Seed Class</u>	<u>App./Cert. No.</u>	<u>Seed Lab No.</u>	<u>Acres</u>	<u>Bulk (lbs) Quantity</u>	<u>Purity</u>	<u>Germ.</u>	<u>Dorm.</u>	<u>Inert</u>	<u>Weed</u>	<u>Other Crop</u>	<u>Test Date</u>
2011	Foundation	C22115	L1105866	1.10	94.0	94.66	87	3	5.32	0.02	0.00	1/25/2012
2012	Foundation	C24915	L1203989	1.10	238.0	98.78	78	9	1.22	0.00	0.00	1/3/2012

SEED PRODUCTION RECORD**Accession:** Pierre (SD-251, PI-476980)**Name/Species:** sideoats grama, *Bouteloua curtipendula***Location:** Field E-11**Year of Establishment:** 2009**Origin/Source:** Stanley County; Ft. Pierre, South Dakota

<u>Prod. Year</u>	<u>Seed Class</u>	<u>App./Cert. No.</u>	<u>Seed Lab No.</u>	<u>Acres</u>	<u>Bulk (lbs) Quantity</u>	<u>Purity</u>	<u>Germ.</u>	<u>Dorm.</u>	<u>Inert</u>	<u>Weed</u>	<u>Other Crop</u>	<u>Test Date</u>
2010	Foundation	C10992	L1005405	1.10	307.0	95.34	84	3	4.66	0.00	0.00	2/8/2011
2011	Foundation	C22247	L1106179	1.10	190.0	94.14	72	5	5.86	0.00	0.00	1/31/2012
2012	Foundation	C25071	L1204417	1.10	404.0	99.4	90	2	0.59	0.00	0.01	1/23/2013

SEED PRODUCTION RECORD

Accession: Pierre (SD-251, PI-476980)

Name/Species: sideoats grama, *Bouteloua curtipendula*

Location: Minot Experiment Station

Year of Establishment: 2004

Origin/Source: Stanley County; Ft. Pierre, South Dakota

<u>Prod. Year</u>	<u>Seed Class</u>	<u>App./Cert. No.</u>	<u>Seed Lab No.</u>	<u>Acres</u>	<u>Bulk (lbs) Quantity</u>	<u>Purity</u>	<u>Germ.</u>	<u>Dorm.</u>	<u>Inert</u>	<u>Weed</u>	<u>Other Crop</u>	<u>Test Date</u>
2004	establishment	S0412378		3.00	0.0							
2005	failed*	S0513917	L2508235	3.00	300.0	97.69	71	20	2.15	0.16	0.00	2/27/2006
2006	common		no test		20.0							
2007	Failed			3.00	307.0							
2008	Foundation	C81558	L2807707	3.00	139.0	98.3	86	1	1.61	0.09	0	3/1/2009
2009	No harvest											
2010	No Harvest											
2011	No harvest											
2012	Removed											

*seed lot failed to meet certification and was prohibited from sale in North Dakota due to excess of 25 seeds/lb of wild oats

SEED PRODUCTION RECORD

Accession: Bad River ecotype (9063064)

Name/Species: blue grama, *Bouteloua gracilis*

Location: Field E-12

Year of Establishment: 2010

Origin/Source: Haakon County; Philip, South Dakota

<u>Prod. Year</u>	<u>Seed Class</u>	<u>App./Cert. No.</u>	<u>Seed Lab No.</u>	<u>Acres</u>	<u>Bulk (lbs) Quantity</u>	<u>Purity</u>	<u>Germ.</u>	<u>Dorm.</u>	<u>Inert</u>	<u>Weed</u>	<u>Other Crop</u>	<u>Test Date</u>
2010	year			1.02								
	no harvest-establishment											
2011	Select	C22849	L1108133	1.00	100.0	95.96	96	0	3.92	0.08	0.04	3/7/2012
2012	Select	C24477	L1202783	0.70	16.0	76.61	68	13	23.33	0.03	0.03	12/4/2012

SEED PRODUCTION RECORD**Accession:** 9094357**Name/Species:** Prairie sandreed, *Calamovilfa longifolia***Location:** Field E-9**Year of Establishment:** 2009**Origin/Source:** composite, Sherburne, Polk, Norman, Douglas, Chisago Counties, Minnesota

Prod.		App./Cert.	Seed		Bulk (lbs)						Other	
Year	Seed Class	No.	Lab No.	Acres	Quantity	Purity	Germ.	Dorm.	Inert	Weed	Crop	Test Date
2010	breeder	C10992		0.25	85 gm							
2011	breeder		No test	0.25	1.2							
2012	breeder		L1202345	0.25	2.5	66.84	69	0	30.08	3.08	0	11/26/2012

SEED PRODUCTION RECORD**Accession:** Bismarck germplasm (9006032)**Name/Species:** purple prairieclover, *Dalea purpurea***Location:** E-12**Year of Establishment:** 2009**Origin/Source:** Lyman County; Presho, South Dakota

Prod.		App./Cert.	Seed		Bulk (lbs)						Other	Test
Year	Seed Class	No.	Lab No.	Acres	Quantity	Purity	Germ.	Dorm.	Inert	Weed	Crop	Date
2010	no harvest	S1010037		0.5								
2011	Select	C23683	L1111282	0.5	44	99.01	29	0	0.99	0		5/16/2012
2012	Select	C25241	L1204921	0.5	12.5	98.57	31	48	1.4	0.03	0	2/6/2013

SEED PRODUCTION RECORD**Accession:** Bismarck germplasm (9076759)**Name/Species:** narrow-leaved purple coneflower, *Echinacea angustifolia***Location:** E-12**Year of Establishment:** 2009**Origin/Source:** composite; McKenzie, Slope, Sioux, Billings, Dunn, Burleigh, Sheridan, Morton, McHenry Counties in North Dakota

<u>Prod. Year</u>	<u>Seed Class</u>	<u>App./Cert. No.</u>	<u>Seed Lab No.</u>	<u>Acres</u>	<u>Bulk (lbs)</u>			<u>Germ.</u>	<u>Dorm.</u>	<u>Inert</u>	<u>Weed</u>	<u>Other Crop</u>	<u>Test Date</u>	<u>Notes</u>
2010	no harvest	S1010036		0.32	0									
2011	Select	C22850	L1108134	0.1	73	84.96	15	49	15.04	0			3/5/2012	
2012	Select	C25542	L1205976	0.1	5	81.79	39	35	18.21	0	0		2/20/2013	

SEED PRODUCTION RECORD

Accession: 'Mandan' (9058908)

Name/Species: Canada wildrye, *Elymus canadensis*

Location: Field D-9

Year of Establishment: 2008

Origin/Source: central North Dakota

Prod.	Seed	App./Cert.	Seed	Bulk (lbs)							Other		
<u>Year</u>	<u>Class</u>	<u>No.</u>	<u>Lab No.</u>	<u>Acres</u>	<u>Quantity</u>	<u>Purity</u>	<u>Germ.</u>	<u>Dorm.</u>	<u>Inert</u>	<u>Weed</u>	<u>Crop</u>	<u>Test Date</u>	<u>Notes</u>
2009	Foundation	C91719	L2908364	1.0	467.0	96.57	76	0	3.43	0	0	4/14/2010	
2010	Common*	C11887	L1008287	0.87	86.0	92.93	67	0	7.06	0.00	0.01	4/19/2011	
2011	Foundation	C23742	L1111529	0.9	159.0	97.17	81	0	2.83	0.00	0.00	6/28/2012	Ergot.04%
2012	Foundation	C25400	L1205502	0.9	179.0	94.63	70	0	5.36	0.01	0.00	3/4/2013	Ergot.02%

* failed certification due to low germination

SEED PRODUCTION RECORD

Accession: Medicine Creek germplasm (ND-3651, 9008065)

Name/Species: Maximilian sunflower, *Helianthus maximiliani*

Location: Field D-11

Year of Establishment: 1983/1985

Origin/Source: Hughes County, South Dakota

Prod. Year	Seed Class	App./Cert. No.	Seed Lab No.	Bulk (lbs)						Other			Notes
				Acres	Quantity	Purity	Germ.	Dorm.	Inert	Weed	Crop	Test Date	
1983	Common		K11447	0.05	3.5	97.03	18		2.90	0.00	0.07	4/27/1984	
1984	Common		K31783	0.05	6.0	91.85	23		4.76	3.39	0.00	5/31/1985	
1985	Common		L9742	0.63	15.0	79.29	41		20.51	0.71	0.03	4/21/1986	
1986	Common		L28597	0.63	8.0	78.05	20		18.21	3.68	0.06	4/2/1987	
1987	Common		M20825	0.63	13.0	71.82	6		27.99	0.15	0.04	5/20/1988	
1988	Common		N17895	0.70	1.3	99.46	11		0.54	0.00	0.00	4/3/1990	
1989	Common		N20601	0.70	4.5	62.66	5		37.24	0.06	0.04	5/4/1990	
1990					0.0								
1991	Common		P03393/P03590	0.70	86.5	92.12	65 (TZ)		7.02	0.86		7/29/1992	
1992	Common		P17831	0.70	31.0	88.38	1	47	11.03	0.59	0.00	5/11/1993	
1993	Common		9312790	0.70	40.5	83.14	1	18	16.57	0.29	0.00	6/13/1994	
1994	Common		9402979	0.70	70.5	84.69	0	63	13.92	1.39	0.00	11/14/1994	
1995	Common		9513275	0.70	31.0	93.57	18	67	5.18	1.25	0.00	3/25/1996	
1996	Common		9604738	0.70	35.5	83.66	15	48	16.05	0.29	0.00	12/19/1996	
1997	Common		9709183	0.70	64.0	83.20	4	70	16.75	0.05	0.00	3/2/1998	
1998	Common		9811399	0.70	96.5	94.27	30	64	5.26	0.47	0.00	4/13/1999	
1999	Select (G1)	990870-1	9909471	0.70	26.0	98.45	18	39	0.68	0.86	0.01	3/20/2000	
2000	Select (G1)	201147-1	2005815	0.70	20.0	98.08	25	60	1.47	0.46	0.00	2/5/2001	
2001	Select (G1)	S0113843	2105127	0.70	15.5	98.10	58	27	0.94	0.96	0.00	1/23/2002	
2002	Select (G1)	S0210293	L2203526	0.70	40.0	95.71	12	79	4.15	0.13	0.01	12/20/2002	
2003	Select (G1)	C56405	L2310636	0.70	60.0	99.02	33	56	0.34	0.58	0.06	4/16/2004	
2004	Select (G1)	S0412050	L2410471	0.70	27.0	91.55	43	54	4.04	4.39	0.02	3/28/2005	
2005	Select (G1)	S0513084	L2503953	0.70	57.0	98.17	6	74	1.12	0.71	0.00	12/27/2006	
2006	Select (G1)	C66808	L2607438	0.70	18.0	91.38	35	38	8.45	0.05	0.12	2/21/2007	
2007	Select (G1)	C71064	L2710351	0.70	48.0	96.26	5	73	3.72	0.02	0.00	4/8/2008	
2008	Select (G1)	C80746	L2804221	0.70	37.0	98.37	4	53	1.61	0.02	0.00	1/1/2009	
2009	Select (G1)	C92148	L2910721	0.70	69.0	98.78	19	67	0.61	0.3	0.31	4/23/2010	
2010	Select (G1)	C1176	L1007816	0.70	40.0	99.69	21	68	0.28	0.01	0.01	3/15/2011	
2011	Select	C24039	L1200284	0.70	14.0	96.18	3	23	3.82	0.00	0.00	8/21/2012	on hold
2012	Select	C25750	L1206678		20.0	99.44	61	18	0.42	0.14	0.00	3/22/2013	

SEED PRODUCTION RECORD

Accession: Bismarck germplasm (9047233)

Name/Species: stiff sunflower, *Helianthus pauciflorus* ssp. *pauciflorus*

Location: Field E-12

Year of Establishment: 2009

Origin/Source: composite

Prod. Year	Seed Class	App./Cert. No.	Seed Lab No.	Acres	Bulk (lbs)			Other				Test Date
					Quantity	Purity	Germ.	Dorm.	Inert	Weed	Crop	
2009	Select (G1)	C91409	L2906675	0.22	9	90.15	13	48	9.84	0.01	0	3/16/2010
2010	Select (G1)	C10494	L1003258	0.09	10.0	96.08	20	72	3.92	0.00	0.00	12/16/2010
2011	Common	Failed	L1107298	0.09	3.0	70.40	12	26	29.59	0.01	0.00	2/21/2012
2012	Select-hold	C25508	L1205823	0.09	3.0	78.10	5	24	21.78	0.12	0.00	2/27/2013 excess weeds

SEED PRODUCTION RECORD

Accession: 'Forestburg' (SD-149, PI-478001)

Name/Species: switchgrass, *Panicum virgatum*

Location: Field D-11

Year of Establishment: 1999

Origin/Source: Sanborn County; Forestburg, South Dakota; composite of SD-62, 205, 206, 203

<u>Prod. Year</u>	<u>Seed Class</u>	<u>App./Cert. No.</u>	<u>Seed Lab No.</u>	<u>Acres</u>	<u>Bulk (lbs)</u>					<u>Other</u>		<u>Test Date</u>
					<u>Quantity</u>	<u>Purity</u>	<u>Germ.</u>	<u>Dorm.</u>	<u>Inert</u>	<u>Weed</u>	<u>Crop</u>	
2000	Foundation	201163-1	2010929	1.2	776	99.96	77	3	0.02	0.02	0.00	4/18/2001
2001	Foundation	S0113837	2111414	1.2	840	99.95	82	0	0.05	0.00	0.00	4/22/2002
2002	Foundation	S0210302	L2205339	1.2	144	99.82	49	29	0.16	0.02	0.00	1/31/2003
2003	Foundation	C56259	L2310164	1.2	157	99.16	88	7	0.72	0.07	0.05	4/22/2004
2004	Foundation	S0412032	L2415348 L2506244	1.2	476.5	99.47	68	2	0.51	0.02	0.00	5/19/2005
2005	Foundation	S0513082	L2515485	1.2	591	98.89	70	0	1.09	0.02	0.00	7/10/2006
2006	Foundation	C67586	L2610436	1.2	200	99.87	87	5	0.11	0.02	0.00	4/20/2007
2007	Foundation	C69781	L2704963	1.2	644	99.9	73	11	0.1	0	0	2/5/2008
2008	Foundation	C81522	L2807508	1.2	287	99.82	82	1	0.18	0	0	4/1/2009
2009	Foundation	C90828	L2904378	1.2	678	99.86	60	5	0.07	0.07	0	2/17/2010
2010	Foundation	C11624	L1007359	1.2	585	99.98	87	2	0.02	0	0	4/1/2011
2011	No harvest											
2012	Failed-common	C25938	L1207292	1.2	222	99.29	87	8	0.02	0.69	0	4/23/2013

SEED PRODUCTION RECORD

Accession: 'Rodan' (PI-477993)

Name/Species: western wheatgrass, *Pascopyrum smithii*

Location: Field E-7

Year of Establishment: 2007

Origin/Source: Field in Morton County; Mandan North Dakota

<u>Prod. Year</u>	<u>Seed Class</u>	<u>App./Cert. No.</u>	<u>Seed Lab No.</u>	<u>Acres</u>	<u>Bulk (lbs) Quantity</u>	<u>Purity</u>	<u>Germ.</u>	<u>Dorm.</u>	<u>Inert</u>	<u>Weed</u>	<u>Other Crop</u>	<u>Test Date</u>	<u>Notes</u>
2009	Foundation	C90741	L2903919	1.0	137.0	91.45	92	1	8.42	0.08	0.05	2/8/2010	
2010	Foundation	C11362	L1006544	1.3	180.0	92.30	84	0	7.70	0.00	0.00	3/24/2011	Ergot
2011	Foundation	C21309	L1102287	1.3	125.0	85.41	61	1	14.57	0.02	0.00	3/20/2012	0.93%
2012	Foundation	C24478	L1202784	1.3	66.0	93.56	71		6.44	0.00	0.00	12/15/2012	

SEED PRODUCTION RECORD

Accession: 'Badlands' ecotype (ND-4115, 9036131)

Name/Species: little bluestem, *Schizachyrium scoparium*

Location: Field E-13 (adjacent to breeder's block)

Year of Establishment: 1989

Origin/Source: western North Dakota and western and central South Dakota

<u>Prod. Year</u>	<u>Seed Class</u>	<u>App./Cert. No.</u>	<u>Seed Lab No.</u>	<u>Acres</u>	<u>Bulk (lbs)</u>			<u>Other</u>				<u>Test Date</u>
					<u>Quantity</u>	<u>Purity</u>	<u>Germ.</u>	<u>Dorm.</u>	<u>Inert</u>	<u>Weed</u>	<u>Crop</u>	
1990	Common		N8367	0.90	28.00	87.89	79	0	12.11	0.00	0.00	4/16/1991
1991	Common		P03212	0.90	78.50	64.08	59	0	35.92	0.00	0.00	5/28/1992
1992	Common		P16680	1.04	199.50	95.86	87	0	4.14	0.00	0.00	5/6/1993
1993	Common		9307613	1.04	83.00	93.94	78	0	6.06	0.00	0.00	4/13/1994
1994	Select (G2)	no tags	9415448	1.04	81.50	95.82	81	0	4.18	0.00	0.00	5/8/1995
1995	Select (G2)	9508543	9508543	1.04	60.00	87.14	67	0	12.84	0.02	0.00	2/21/1996
1996	Select (G2)	960047-1	9606987	2.17	113.00	86.11	75	0	13.85	0.02	0.02	2/18/1997
1997	Select (G2)	970040-1	9705283	2.17	221.50	93.87	80	0	6.13	0.00	0.00	1/23/1998
1998	Select (G2)	980064-1	9810818	2.17	53.00	66.21	72	0	33.75	0.02	0.02	4/19/1999
1999	Select (G2)	990861-1	9911692	2.17	210.00	74.00	70	0	25.98	0.00	0.02	5/1/2000
2000	Select (G2)	201157-1	2002928	2.17**	108.50	89.69	84	1	10.31	0.00	0.00	12/27/2000
2000	Select (G2)	201157-1	2003249	12rows	52.00	93.70	84	0	6.26	0.02	0.02	1/3/2001
2001	Select (G2)	S0113840	2111940	2.17	247.00	92.60	88	0	7.38	0.02	0.00	5/2/2002
2002	Select (G2)	S0210304	L2209496	2.17	334.00	92.45	75	2	7.55	0.00	0.00	3/25/2003
2003	Select (G2)	C55305	L2306970	2.17	365.00	95.94	84	3	4.06	0.00	0.00	2/23/2004
2004	Select (G2)	S0412039	L2406861	2.20	89.00	95.98	71	16	3.85	0.15	0.02	2/22/2005
2004	Select (G2)	S0412039	L2406860	2.20	224.00	96.83	67	16	3.17	0.00	0.00	2/15/2005
2005	Select (G2)	S0513073	L2505889	2.20	390.00	93.79	79	7	6.19	0.02	0.00	1/31/2006
2006	Select (G2)	C66297	L2605801	2.20	241.00	94.17	65	24	5.81	0.00	0.02	1/25/2007
2007	Select (G2)	C71147	L2710754	2.20	227.00	92.66	66	20	7.19	0.13	0.02	4/14/2008
2008	Select (G2)	C82181	L2810250	2.20	90.00	95.14	86	0	4.69	0.17	0.00	4/30/2009
2009	Select (G2)	C10612	L1003847	2.20	217.00	97.15	84	2	2.77	0.09	0.00	1/3/2011
2010	Select (G2)	C10611	L1003846	2.20	78.00	92.58	82	9	7.29	0.13	0.00	1/3/2011
2011	No Harvest											
2012	Select (G2)	C25751	L1206679	2.20	131.00	97.42	67	9	2.56	0.02	0.00	3/26/2013

*1992 and 1993 harvest is a composite of field and 340 plant breeder's block

**This acreage amount includes the 12 rows sprayed with plateau

SEED PRODUCTION RECORD**Accession:** 'Red River' germplasm (9069159)**Name/Species:** prairie cordgrass, *Spartina pectinata***Location:** Field E-9**Year of Establishment:** 2003**Origin/Source:** North Dakota, South Dakota, and Minnesota

<u>Prod. Year</u>	<u>Seed Class</u>	<u>App./Cert. No.</u>	<u>Seed Lab No.</u>	<u>Acres</u>	<u>Bulk (lbs) Quantity</u>	<u>Purity</u>	<u>Germ.</u>	<u>Dorm.</u>	<u>Inert</u>	<u>Weed</u>	<u>Other Crop</u>	<u>Test Date</u>
2004		S0412035		1.50	0.0							
2005	combined with field D-11											
2006	No harvest											
2007	Bulked with field D-11											
2008	Select (G1)	C81022	L2805573	1.5	31.0	57.83	11	54	42.17	0	0	2/1/2009
2009	Select (G1)	C91876	L2905605	1.5	16.0	58.96	58	27	36.67	0.36	4.01	3/3/2010
2009	Select (G1)	C91876	L2909248	1.5	11.0	68.78	58	27	30.68	0.01	0.53	3/29/2010
2010	No harvest											
2011	Common	Failed	L1200004	1.50	10.0	80.99	28	53		1.78	0.49	7/24/2012
2012	Removed											

SEED PRODUCTION RECORD**Accession:** 'Red River' germplasm (9069159)**Name/Species:** prairie cordgrass, *Spartina pectinata***Location:** Field E-7**Year of Establishment:** 2010**Origin/Source:** North Dakota, South Dakota, and Minnesota

<u>Prod. Year</u>	<u>Seed Class</u>	<u>App./Cert. No.</u>	<u>Seed Lab No.</u>	<u>Acres</u>	<u>Bulk (lbs) Quantity</u>	<u>Purity</u>	<u>Germ.</u>	<u>Dorm.</u>	<u>Inert</u>	<u>Weed</u>	<u>Other Crop</u>	<u>Test Date</u>
2010	No Harvest											
2011	Select	C24001	L1200003	1.25	45.0	90.96	53	37	9.01	0.03	0.00	7/24/2012
2012	Select	C25431	L1205621	1.25	50.0	97.76	6	74	2.06	0.17	0.01	3/26/2013

SEED PRODUCTION RECORD

Accession: 'Manifest'

Name/Species: pubescent wheatgrass, *Thinopyrum intermedia*

Location: Field E-12

Year of Establishment: 2006

Origin/Source: USDA, ARS, Mandan, North Dakota

Prod.		App./Cert.	Seed		Bulk (lbs)					Other		
Year	Seed Class	No.	Lab No.	Acres	Quantity	Purity	Germ.	Dorm.	Inert	Weed	Crop	Test Date
2007	Foundation	C70776	L2709076	1.2	708.0	97.86	92	0	2.02	0.01	0.11	4/1/2008
2008	Foundation	C80609	L2803367	1.2	331.0	98.64	88	0	1.35	0.00	0.01	1/1/2009
2009	Foundation	C91062	L2905217	1.2	462.0	94.96	85	0	5.04	0.00	0.00	3/3/2010
2010	Foundation	C10796	L1004520	1.3	500.0	98.79	97	0	1.21	0.00	0.00	2/7/2011
2011	Foundation	C23684	L1111283	1.3	150.0	98.40	95	0	1.60	0.00	0.00	5/30/2012
2012	Foundation	C26156	L1208127	1.3	394.0	94.41	97	0	5.59	0.00	0.00	5/1/2013

SEED PRODUCTION RECORD

Accession: 'Reliant' (Mandan-1813, PI-556987)

Name/Species: intermediate wheatgrass, *Thinopyrum intermedia*

Location: Field D-7

Year of Establishment: 1989

Origin/Source: USDA, ARS, Mandan, North Dakota

<u>Prod. Year</u>	<u>Seed Class</u>	<u>App./Cert. No.</u>	<u>Seed Lab No.</u>	<u>Acres</u>	<u>Bulk (lbs)</u>			<u>Germ.</u>	<u>Dorm.</u>	<u>Inert</u>	<u>Weed</u>	<u>Other Crop</u>	<u>Test Date</u>
					<u>Quantity</u>	<u>Purity</u>							
1990	Foundation	1673	N12763	0.92	397.0	99.39	94		0.61	0.00	0.00	6/27/1991	
1991	Foundation	2144	N16914	0.92	171.5	98.33	90		1.65	0.01	0.01	12/17/1991	
1992	Foundation	1044-1	P09589	0.92	157.0	98.23	90		1.77	0.00	0.00	2/2/1993	
1993				0.92	No harvest								
1994	Foundation	940234-1	9407584	0.92	96.5	97.33	98		2.67	0.00	0.00	2/6/1995	
1995	Foundation	950192-1	9510849	0.92	286.5	97.39	85	0	2.59	0.01	0.01	3/12/1996	
1996	Foundation	960048-1	9606991	0.92	218.5	93.51	92	0	6.49	0.00	0.00	2/13/1997	
1997	Foundation	970039-1	9705284	0.92	383.0	98.73	98	0	1.27	0.00	0.00	1/14/1998	
1998	Foundation	981858-1	9806829	0.92	360.0	98.09	97	0	1.91	0.00	0.00	2/26/1999	
1999	Foundation	990856-1	9906202	0.92	260.0	96.55	96	0	3.44	0.00	0.01	2/22/2000	
2000	Foundation	201146-1	2006168	0.92	150.0	96.09	93	0	3.89	0.02	0.00	2/20/2001	
2001	Hail				No harvest								
2002	Foundation	S0210288	L2208213	0.92	123.0	98.33	96	0	1.66	0.01	0.00	3/3/2003	
2003	Foundation	C56315	L2310270	0.92	223.0	97.74	88	0	2.24	0.01	0.01	4/22/2004	
2004	Foundation	C59967	L2409682	0.90	181.0	97.34	94	XX	2.63	0.00	0.03	4/4/2005	
2005	Foundation	C61875	L2502733	0.90	150.0	96.04	91	XX	3.95	0.01	0.00	12/21/2005	
2006	Foundation	C66479	L2606470	0.90	66.0	99.23	95	XX	0.77	0.00	0.00	2/13/2007	
2007	Foundation	C69782	L2704964	0.90	274.0	99.45	95	0	0.53	0.01	0.01	1/30/2008	
2008	Foundation	C81232	L2806510	0.90	190.0	98.40	94	0	1.60	0.00	0.00	3/18/2009	
2009	Foundation	C92474	L2911994	0.90	350.0	97.94	97	0	2.05	0.01	0.00	5/6/2010	
2010	Foundation	C11829	L1008057	0.90	182.0	98.50	97	0	1.50	0.00	0.00	4/14/2011	
2011	Foundation	C23751	L1111638	0.90	204.0	96.82	90	0	3.15	0.03	0.00	7/26/2012	
2012	Foundation	C25203	L1204768	0.90	100.0	98.29	98	0	1.69	0.00	0.02	2/14/2013	

STAFFING

STAFFING: TECHNICAL REPORT 2011-2012

PERMANENT POSITIONS

Wayne L. Duckwitz, Manager

Craig M. Stange, Forester

Nancy K. Jensen, Agronomist

Earl G. Aune, Biological Science Technician (Foreman)

Michael D. Bellon, Biological Science Technician (Jan 2011 to Aug 2011) (EOD Sept 2012)

Rachel H. Bergsagel, Biological Science Technician

Janet M. Caolo-Tanski, Biological Science Technician (Sept 2011 to Aug 2012)

Julius C. Saylor, Office Automation Clerk (EOD Sept 2011)

SEASONAL POSITIONS:

Dennis DeVault, Seasonal Biological Science Aid (2011, 2012)

Ryder A. Schwagler, Seasonal Biological Science Aid (2011)

Kyle Wolf, Seasonal Biological Science Aid (2011)

Kevin M. Cortes, WAE, Seasonal Biological Science Aid (2012)

Brandon C. Alveshere, WAE, Seasonal Biological Science Aid (2012)

Teal R. Jacobson, WAE, Seasonal Biological Science Aid (2012)

INFORMATION

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Publications - Fiscal Year 2011

- Wayne Duckwitz 2011. Badlands National Park Annual Report 2010. USDA Natural Resources Conservation Service, Bismarck, North Dakota. March 2011. 2p.
- Wayne Duckwitz 2011. Grand Teton National Park Annual Report 2010. USDA, NRCS Plant Materials Center, Bismarck, ND. March 2011. 2p.
- Wayne Duckwitz 2010. Improved Forage Grass Releases by the Bismarck PMC and Partners. Minnesota Forage Research Symposium, St. Cloud, MN. November 17-18, 2010. 1p.
- Wayne Duckwitz 2011. Theo. Roosevelt National Park Annual Report 2010. USDA NRCS Plant Materials Center, Bismarck, North Dakota. March 2011. 2p.
- Tober, Dwight, and Wayne Duckwitz 2010. Grass Variety Development and Performance Testing. Minnesota Forage Research Symposium Proceedings, St. Cloud, MN. November 17-18, 2010. 1p.
- Tober, Dwight, and Wayne Duckwitz 2010. North Dakota - Grass Variety Development and Performance Testing. Forage Focus, Midwest Forage Association, St. Paul, MN. December 2010. 1p.
- Tober, Dwight, and Rachel Bergsagel 2011. 2010 Report, Off-Center Evaluation Planting of Woody Plant Materials, Becker, Minnesota. USDA, NRCS, Plant Materials Center, Bismarck, ND. March 2011. 5p.
- Tober, Dwight, and Rachel Bergsagel 2011. 2010 Report, Off-Center Evaluation Planting of Woody Plant Materials, Brookings, South Dakota. USDA, Natural Resources Conservation Service, Bismarck, ND. March 2011. 4p.
- Tober, Dwight, and Rachel Bergsagel 2011. 2010 Report, Off-Center Evaluation Planting of Woody Plant Materials, Grand Rapids, Minnesota. USDA, NRCS, Plant Materials Center, Bismarck, ND. March 2011. 4p.
- Tober, Dwight 2011. Seed News - 2011. USDA, NRCS, Plant Materials Center, Bismarck, ND. February 2011. 2p.
- Tober, D., N. Jensen, and W. Duckwitz 2011. Prairie Sandreed (*Calamovilfa longifolia*) and Sand Bluestem (*Andropogon hallii*) Performance Trials - North Dakota, South Dakota, and Minnesota. USDA, NRCS Plant Materials Center, Bismarck, North Dakota. June 2011. 20p.
- Stange, Craig, and Rachel Bergsagel 2011. 2010 Report, Off-Center Evaluation of Woody Plant Materials, Dickinson, North Dakota. USDA-NRCS Plant Materials Center, Bismarck, ND. March 2011. 4p.
- Stange, Craig 2011. Trees in the Water. USDA, NRCS Plant Materials Center, Bismarck, North Dakota. June 23, 2011. 1p.
- Smith, Sheryl, and Nancy Jensen 2011. Wildflowers of North Dakota and their Medicinal Uses, Part 2. USDA, NRCS Plant Materials Center, Bismarck, ND. January 2011. 2p.
- Sedivec, Kevin, Dwight Tober, Wayne Duckwitz, and John Hendrickson 2011. Grass Varieties for North Dakota. North Dakota State University Extension Service, Fargo, ND and USDA, NRCS, Bismarck, ND, Fargo, ND. June 2011.
- Plant Materials Center 2011. Seeding Pollinator Plots. USDA, NRCS Plant Materials Center, Bismarck, North Dakota. March 2011. 5p.
- Nancy Jensen 2011. Growers of Bismarck Plant Materials Center Grass and Forb Releases - January 2011. USDA-NRCS Plant Materials Center, Bismarck, ND. January 2011. 3p.
- Knudson, Mike, and Rachel Bergsagel 2011. 2010 Report, Off-Center Evaluation of Woody Plant

Materials, Bottineau, North Dakota. USDA, NRCS Plant Materials Center, Bismarck, ND. March 2011. 3p.

Craig Stange 2011. Rain Gardens: A Pretty Way to Reduce Runoff and Improve Water Quality. ND Water Magazine, Bismarck, ND. Voume 19, Issue 5. 4p.

Bismarck Plant Materials Center 2011. 2010 Progress Report of Activities. USDA, NRCS, Plant Materials Center, Bismarck, North Dakota. January 2011. 8p.

Bismarck Plant Materials Center 2011. 'Manifest' intermediate wheatgrass. USDA NRCS Plant Materials Center, Bismarck, ND. August 2011. 2p.

Bismarck Plant Materials Center 2010. Notice of Release: Riverview Germplasm American black currant (*Ribes americanum*). USDA-NRCS Plant Materials Center, Bismarck, ND. September 2010. 15p.

Bismarck Plant Materials Center 2010. Plant Chat, Fall 2010. USDA-NRCS Plant Materials Center, Bismarck, ND. Volume 10, Issue 4. 1p.

Bismarck Plant Materials Center 2011. Plant Chat, Spring 2011. USDA NRCS Plant Materials Center, Bismarck, North Dakota. April 2011. 1p.

Bismarck Plant Materials Center 2011. Plant Chat, Summer 2011. USDA NRCS Plant Materials Center, Bismarck, ND. August 2011. 1p.

Bismarck Plant Materials Center 2011. Plant Chat, Winter 2011. USDA-NRCS Plant Materials Center, Bismarck, ND. Volume 11, Issue 1. 1p.

Bismarck Plant Materials Center 2011. Technical Report 2010, Part 2 of 2: Trees and Shrubs. USDA NRCS Plant Materials Center, Bismarck, North Dakota. September 2011. 175p.

Bismarck Plant Materials Center 2011. Woody Notes, January 2011. USDA-NRCS Plant Materials Center, Bismarck, ND. January 2011. 2p.

Publications - Fiscal Year 2012

Stange, Craig 2012. Tree Selection, Care and Management - KFYR. USDA NRCS Plant Materials Center, Bismarck, ND. May 30, 2012.

Stange, Craig 2012. Tree Selection, Care and Management - KXMB. USDA NRCS Plant Materials Center, Bismarck, ND. May 30, 2012.

Bismarck Plant Materials Center 2012. 2011 Progress Report of Activities. USDA NRCS Plant Materials Center, Bismarck, ND. January 2012. 9p.

Bismarck Plant Materials Center 2012. Badlands National Park Annual Report 2011. USDA NRCS Plant Materials Center, Bismarck, ND. April 17, 2012. 2p.

Bismarck Plant Materials Center 2012. Bounty Germplasm Big Bluestem. USDA-NRCS Plant Materials Center, Bismarck, ND. August 2012. 2p.

Bismarck Plant Materials Center 2012. 'Cardan' Green Ash. USDA-NRCS Plant Materials Center, Bismarck, ND. August 2012. 2p.

Bismarck Plant Materials Center 2012. 'Centennial' Cotoneaster. USDA-NRCS Plant Materials Center, Bismarck, ND. August 2012. 2p.

Bismarck Plant Materials Center 2012. 'Dacotah' Switchgrass. USDA-NRCS Plant Materials Center, Bismarck, ND. August 2012. 2p.

Bismarck Plant Materials Center 2012. 'Forestburg' Switchgrass. USDA-NRCS Plant Materials Center, Bismarck, ND. August 2012. 2p.

Bismarck Plant Materials Center 2012. Grand Teton National Park Annual Report 2011. USDA NRCS Plant Materials Center, Bismarck, ND. April 17, 2012. 2p.

Bismarck Plant Materials Center 2012. 'Homestead' Arnold Hawthorn. USDA-NRCS Plant Materials Center, Bismarck, ND. August 2012. 2p.

Bismarck Plant Materials Center 2012. 'Mankota' Russian Wildrye. USDA-NRCS Plant Materials Center, Bismarck, ND. August 2012. 2p.

Bismarck Plant Materials Center 2012. Notice of Release of Bounty Germplasm Big Bluestem: A Selected Class of Natural Germplasm. Native Plants Journal, Bismarck, ND. 13(2):91-94. 4p.

Bismarck Plant Materials Center 2012. Notice of Release of Prairie Harvest Germplasm Common Hackberry: selected class of natural germplasm. Native Plants Journal, 12(3):257-261. 5p.

Bismarck Plant Materials Center 2012. 'Oahe' Hackberry. USDA-NRCS Plant Materials Center, Bismarck, ND. August 2012. 2p.

Bismarck Plant Materials Center 2011. Plant Chat, Fall 2011. USDA-NRCS Plant Materials Center, Bismarck, ND. Volume 11, Issue 4. 1p.

Bismarck Plant Materials Center 2012. Plant Chat, Spring 2012. USDA NRCS Plant Materials Center, Bismarck, ND. Volume 12, Issue 1. 1p.

Bismarck Plant Materials Center 2012. Plant Chat, Summer 2012. USDA-NRCS Plant Materials Center, Bismarck, ND. Volume 12, Issue 2. 5p.

Bismarck Plant Materials Center 2012. Publications Available from the Bismarck Plant Materials Center. USDA NRCS Plant Materials Center, Bismarck, ND. December 2012. 3p.

Bismarck Plant Materials Center 2012. Red River Natural Germplasm Prairie Cordgrass. USDA-NRCS Plant Materials Center, Bismarck, ND. August 2012. 2p.

Bismarck Plant Materials Center 2012. 'Rodan' Western Wheatgrass. USDA NRCS Plant Materials Center, Bismarck, ND. August 2012. 2p.

Bismarck Plant Materials Center 2012. Seed News 2012. USDA NRCS Plant Materials Center, Bismarck, ND. February 2012. 2p.

Bismarck Plant Materials Center 2012. Technical Report 2010, Part 1 of 2: Grasses, Forbs, and Legumes. USDA-NRCS Plant Materials Center, Bismarck, ND. March 2012. 185p.

Bismarck Plant Materials Center 2012. Theodore Roosevelt National Park Annual Report 2011. USDA NRCS Plant Materials Center, Bismarck, ND. April 17, 2011. 2p.

Bismarck Plant Materials Center 2012. Woody Notes, February 2012. USDA NRCS Plant Materials Center, Bismarck, ND. February 2012. 2p.