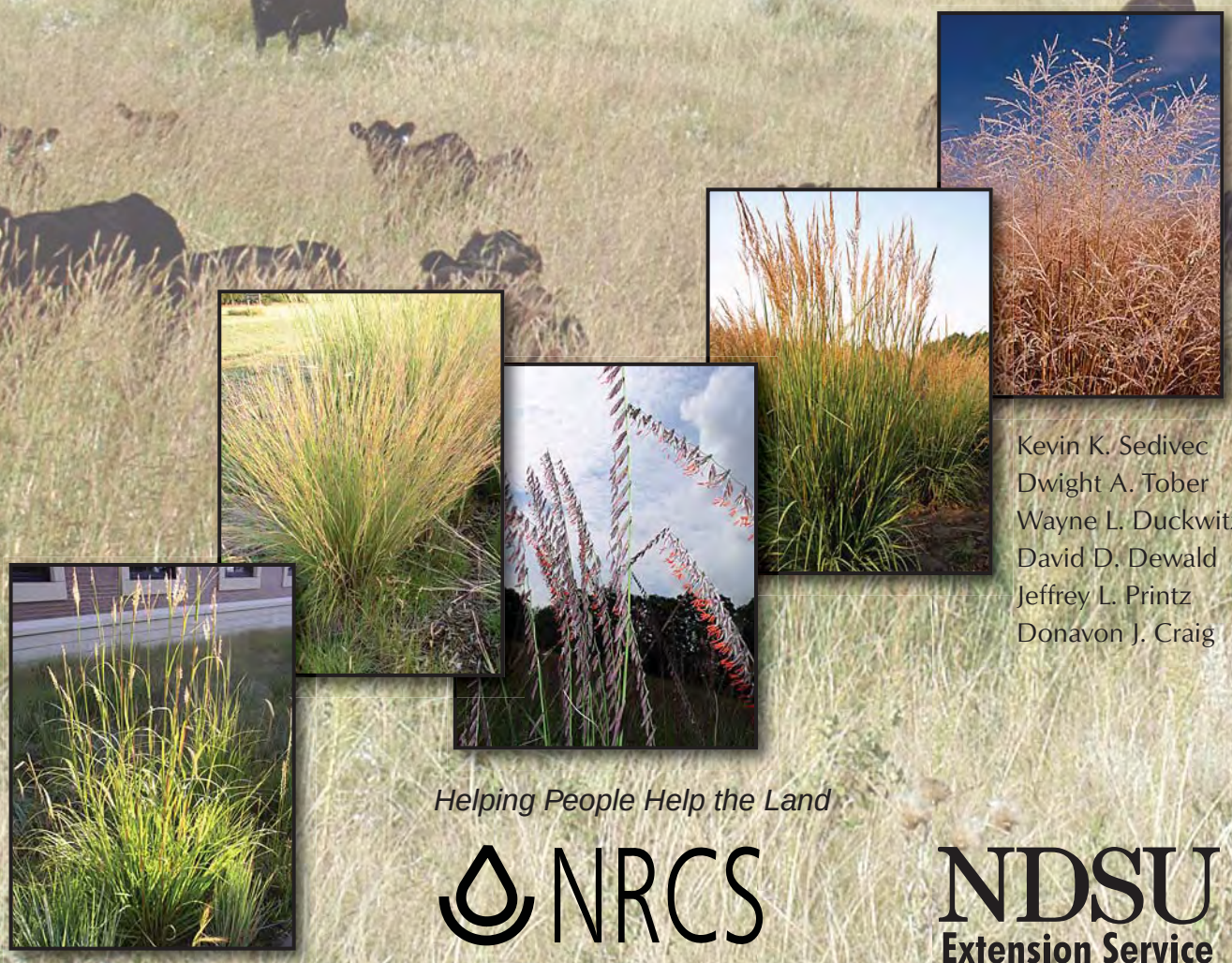
R-1390

Grasses
for the Northern Plains
Growth Patterns, Forage Characteristics and Wildlife Values

Volume II - Warm-season



Kevin K. Sedivec
Dwight A. Tober
Wayne L. Duckwitz
David D. Dewald
Jeffrey L. Printz
Donavon J. Craig

Helping People Help the Land

NRCS
U.S. Department of Agriculture
Natural Resources Conservation Service

NDSU
Extension Service
North Dakota State University
Fargo, North Dakota 58105

JUNE 2009

Contents

The authors include **Kevin K. Sedivec**, state Extension rangeland specialist, School of Natural Resource Sciences, North Dakota State University, Fargo, N.D.; **Dwight A. Tober**, plant materials specialist; **Wayne L. Duckwitz**, plant materials center manager; **David D. Dewald**, state biologist; **Jeffrey L. Printz**, state rangeland management specialist; and **Donavon J. Craig,** research assistant, University of Nevada Las Vegas.

Cooperators and partners in the warm-season grass evaluation trials, together with NDSU and the USDA, NRCS Plant Materials Center at Bismarck, North Dakota, have included: the U.S. Department of Interior, Fish and Wildlife Service (J. Clark Salyer National Wildlife Refuge near Upham, North Dakota; the Wetland Management District at Fergus Falls, Minnesota; and the Karl E. Mundt National Wildlife Refuge near Pickstown, South Dakota); the South Dakota Department of Agriculture Forestry Division; the South Dakota Department of Game, Fish, and Parks; the Minnesota Department of Natural Resources, Division of Forestry; the U.S. Army Corps of Engineers; the USDA, NRCS field and area offices and Soil and Water Conservation District offices located at Bottineau, North Dakota; Fergus Falls, Minnesota; Lake Andes, South Dakota; Onida, South Dakota; Rochester, Minnesota, and Pierre, South Dakota; the Southeastern Minnesota Association of Soil and Water Conservation Districts; the Hiawatha Valley Resource Conservation and Development Area (Minnesota); and the North Central Resource Conservation and Development Office (South Dakota).

Background cover photo: Kenny Miller, Fort Rice, N.D. All other cover photos: NRCS and NDSU Extension Service. Seed photos: E. Brent Turnipseed, Ph.D., professor/director, Seed Testing Laboratory, South Dakota State University, Brookings.

Introduction

Grasses commonly are planted as permanent forage for livestock production, cover type for wildlife habitat and conservation practices for soil protection. They provide a major staple in the diets of domestic and wild herbivores, habitat structure for many wildlife species and ground cover to stabilize soils. Both cool- and warm-season grasses are utilized, depending on the resource needs and objectives of the land manager. Cool-season grasses are defined as plants that produce the major portion of their growth during late spring/early summer, with a second growth occurring in late summer/early fall, depending on moisture conditions. Warm-season grasses produce most or all of their growth during the late spring to early fall period. This publication will concentrate on selected warm-season grasses, listing the most pertinent releases adapted to the Northern Plains. For information on cool-season grasses, see publication "Grasses for the Northern Plains: Growth Patterns, Forage Characteristics and Wildlife Values. Volume I — Cool-season" (Sedivec et al. 2008).

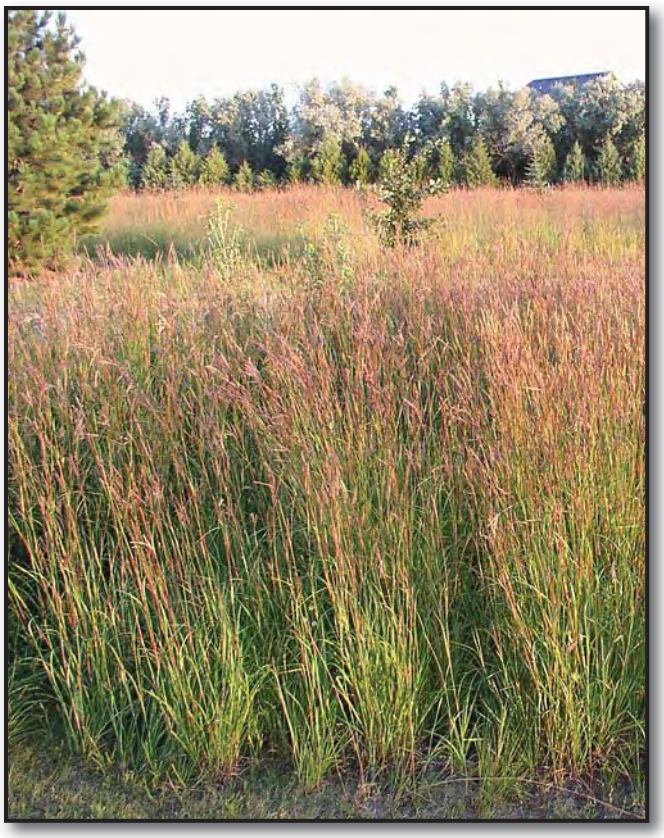
Selection of the proper species and variety is an important step when choosing a grass seeding mixture. Grass species and varieties differ in growth habitat, productivity, forage quality, drought resistance, tolerance to grazing, winter hardiness, seedling vigor, salinity tolerance and many other characteristics. Therefore, selection should be based on the climate, soils, intended use and planned management. Planting the proper selection also can provide long-term benefits and affect future productivity of the stand.

This publication is designed to summarize the growth patterns; forage characteristics, including nutritional value and herbage production; plant performance characteristics, including stand density index, stand rating and disease; fiber content; wildlife values; and a list of varieties suited to the Northern Plains ecoregion. This select group of warm-season grasses was studied at seven field trial locations and two experiments in North and South Dakota and Minnesota. The first experiment, or original study, was conducted during a period of 11 years beginning in 1982 under different environmental conditions at Upham, N.D.; Onida, Fort Pierre and Lake Andes, S.D.; and Fergus Falls and Rochester, Minn. The second experiment was a growth pattern and nutritional study conducted at Hettinger, N.D., and Fort Pierre, S.D., in 1999 and 2000. Recommended seeding rates and specific guidelines can be obtained by consulting your county conservation district, Natural Resources Conservation Service (NRCS) or Extension Service office.

Performance and adaptation of warm-season grasses differ by point of seed origin. Adaptation trials in the Northern Plains have shown that seed sources of warm-season grasses generally can be moved 300 miles north or 200 miles south of their origin without serious adaptation difficulties.

Grass Species and Varieties

The six original field trials included 33 accessions/varieties of seven different grass species (Table 1). They were evaluated for stand density index, stand rating, herbage production and phenology from 1982 to 1992. The Hettinger site was seeded in 1998 and included additional entries. The second experiment, which included 11 and 14 accessions/varieties of six and seven different grass species, were evaluated for growth pattern, forage characteristics, nutritional quality and fiber content from 1999 to 2000 at Hettinger, N.D., and Fort Pierre, S.D. (Table 1). The warm-season grasses at Hettinger and Fort Pierre were selected for this second study based upon popularity and future potential. All species are native to North America. The second study will be further referenced throughout the remainder of this document as the Growth Pattern and Nutritional Study (GPNS). The USDA PLANTS database was used for taxonomic nomenclature (USDA NRCS 2008).



Big bluestem.

Table 1. List of grass species and variety of each warm-season grass tested near Upham and Hettinger, N.D.; Onida, Lake Andes and Fort Pierre, S.D.; and Fergus Falls and Rochester, Minn.

Grass Species	Common Name	Release
Andropogon gerardii	Big bluestem	Bison
Andropogon gerardii	Big bluestem	Sunnyview
Andropogon gerardii	Big bluestem	Bonilla
Andropogon gerardii	Big bluestem	Champ
Andropogon gerardii	Big bluestem	Pawnee
Andropogon gerardii	Big bluestem	Kaw
Andropogon gerardii	Big bluestem	Rountree
Andropogon hallii	Sand bluestem	Garden
Andropogon hallii	Sand bluestem	Goldstrike
Bouteloua curtipendula	Sideoats grama	Butte
Bouteloua curtipendula	Sideoats grama	Pierre
Bouteloua curtipendula	Sideoats grama	Trailway
Bouteloua curtipendula	Sideoats grama	Killdeer
Bouteloua gracilis	Blue grama	Bad River
Bouteloua gracilis	Blue grama	Willis
Calamovilfa longifolia	Prairie sandreed	Goshen
Calamovilfa longifolia	Prairie sandreed	Bowman
Panicum virgatum	Switchgrass	Dacotah
Panicum virgatum	Switchgrass	Forestburg
Panicum virgatum	Switchgrass	Sunburst
Panicum virgatum	Switchgrass	Nebraska 28
Panicum virgatum	Switchgrass	Summer
Panicum virgatum	Switchgrass	Pathfinder
Panicum virgatum	Switchgrass	Trailblazer
Panicum virgatum	Switchgrass	Cave-in-Rock
Panicum virgatum	Switchgrass	Blackwell
Schizachyrium scoparium	Little bluestem	Badlands
Schizachyrium scoparium	Little bluestem	Camper
Schizachyrium scoparium	Little bluestem	Blaze
Schizachyrium scoparium	Little bluestem	Aldous
Schizachyrium scoparium	Little bluestem	Cimarron
Sorghastrum nutans	Indiangrass	Oto
Sorghastrum nutans	Indiangrass	Osage
Sorghastrum nutans	Indiangrass	Rumsey
Sorghastrum nutans	Indiangrass	Holt
Sorghastrum nutans	Indiangrass	Tomahawk

Plots near Fergus Falls, Minnesota.

Plots near Fort Pierre, South Dakota.

Study Area and Design

The GPNS portion of this research and demonstration project was conducted on private land south of Hettinger, N.D., and public land northwest of Fort Pierre, S.D. All grass species and varieties were planted on a Shambo loam near Hettinger and Promise soil series near Fort Pierre. Shambo soils are classified as fine loamy, mixed, super-active, frigid, Typic Haplustolls with nearly level slope (Ulmer and Conta 1987). Promise soil is classified as clay with nearly level slope, somewhat poor drainage, moderate levels of organic matter and poor tilth (Borchers 1980). The other five sites were on the U.S. Fish and Wildlife Service J. Clark Salyer National Wildlife Refuge near Upham, N.D., on a Great Bend silty clay loam; U.S. Fish and Wildlife Service Karl E. Mundt National Wildlife Refuge near Lake Andes, S.D., on an Agar silt loam; South Dakota Department of Game, Fish and Parks land near Onida, S.D., on a Lowry silt loam; the U.S. Fish and Wildlife Service Wetland Management District near Fergus Falls, Minn., on a Barnes and Langhei loam; and Minnesota Department of Natural Resources land near Rochester, Minn., on a Mount Carrol silt loam.

All varieties or experimental lines were seeded in plots that varied in size from 12 to 15 feet wide and 60 to 100 feet in length. They were seeded with a native grass drill (Truax®) on June14-16, 1982, at Upham; May 23-24, 1984, at Onida; June 7-9, 1982, at Fergus Falls; May 20-21, 1986, at Fort Pierre; June 7-8, 1983, at Lake Andes; June 4-5, 1985, at Rochester; and May 5, 1998, at Hettinger using a randomized complete block design with three replications (Figure 1). Seeding rate varied with species but followed recommended seeding rates as specified in the NRCS Field Office Technical Guide (USDA NRCS 2006).

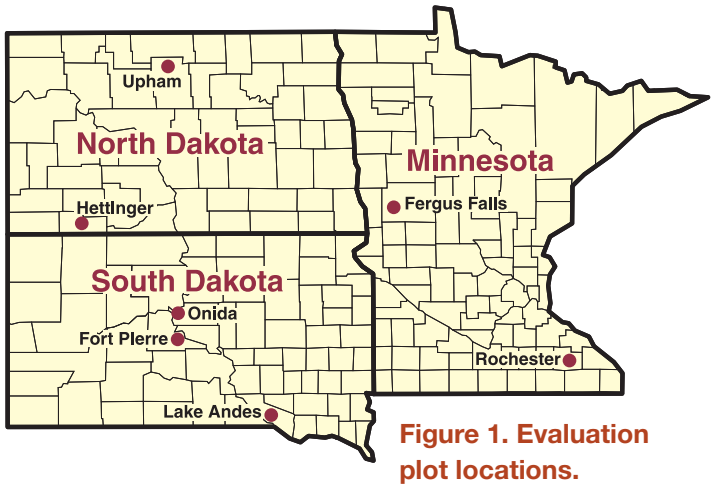


Figure 1. Evaluation plot locations.

Climate

North and South Dakota and Minnesota are near the geographic center of North America, resulting in a continental climate characterized by continuous air movement and large annual, daily and within-a-day temperature changes. Relative humidity is low and precipitation tends to be irregular in time and distribution in the western two-thirds of the Dakotas. Relative humidity tends to be higher and precipitation greater and more frequent in the eastern Dakotas and Minnesota.

Seventy to 75 percent of the annual precipitation falls during the spring and summer months, with 40 to 50 percent falling during May, June and July in North and South Dakota and Minnesota. Monthly precipitation and the long-term average are presented for each location during the corresponding study period (Tables 2-8).

Table 2. Monthly precipitation at Hettinger Experiment Station, Hettinger, N.D., for 1998-2000.

Month	1998	1999	2000	Average
January	0.24	0.29	0.14	0.30
February	1.47	0.31	0.64	0.32
March	0.60	0.59	0.83	0.60
April	0.50	0.94	1.16	1.59
May	1.37	2.05	3.07	2.54
June	2.79	3.36	2.41	2.95
July	1.17	2.44	2.61	2.16
August	1.57	3.16	0.70	1.46
September	0.57	0.77	0.32	1.40
October	4.18	0.26	1.00	1.35
November	0.62	0.52	0.54	0.53
December	0.00	0.30	0.19	0.31
Totals	**15.08**	**14.99**	**13.61**	**15.51**

Table 3. Monthly precipitation from the official weather station at Fort Pierre, S.D., for 1986-1992 and 1998-2000.

Month	1986	1987	1988	1989	1990	1991	1992	1998	1999	2000	Average
January	0.43	0.03	0.11	0.08	0.02	0.28	0.72	0.28	0.40	0.40	0.28
February	0.99	2.70	0.18	0.47	0.33	1.33	0.62	0.76	0.62	0.33	0.83
March	1.36	2.47	0.22	1.15	0.74	0.63	1.23	1.81	0.18	0.98	1.08
April	6.38	0.18	0.81	1.19	2.33	2.74	0.27	2.62	1.73	3.37	2.16
May	3.35	4.34	2.41	0.89	1.73	6.26	0.65	1.57	1.82	3.74	2.68
June	3.19	1.19	3.64	0.53	2.13	3.36	3.69	3.38	2.03	4.42	2.76
July	2.75	1.56	0.33	1.65	2.25	0.55	6.04	3.78	3.40	2.28	2.46
August	1.44	2.42	0.94	1.30	1.03	1.07	2.42	0.64	1.12	1.74	1.41
September	2.12	0.66	1.08	4.06	0.89	0.81	1.41	1.35	0.31	0.92	2.15
October	0.87	0.07	0.26	0.97	0.54	1.41	0.29	0.44	3.21	4.82	1.29
November	1.13	0.20	0.38	0.65	0.09	0.40	1.33	1.20	0.03	0.56	0.60
December	0.00	0.98	0.42	0.37	0.26	0.11	0.20	0.37	0.29	0.16	0.32
Totals	**24.01**	**16.80**	**10.78**	**13.31**	**12.34**	**18.95**	**18.87**	**18.20**	**15.14**	**23.72**	**18.02**

Table 4. Monthly precipitation from the official weather station at Rochester, Minn., for 1986-1991.

Month	1986	1987	1988	1989	1990	1991	Average
January	0.59	0.58	1.16	0.41	0.55	0.67	0.78
February	0.61	0.30	0.21	0.42	0.71	0.45	0.74
March	2.15	1.28	1.60	1.59	3.58	2.82	1.77
April	3.80	1.01	2.43	3.56	6.47	5.25	2.72
May	3.40	2.03	2.33	1.74	4.52	3.84	3.39
June	5.04	3.69	1.59	2.39	9.27	2.25	3.71
July	6.00	7.24	1.12	2.75	8.29	5.30	4.20
August	3.17	3.85	2.87	5.62	5.30	4.66	3.87
September	10.50	2.04	3.77	0.61	1.30	2.31	3.46
October	3.57	1.60	0.36	1.60	1.86	1.99	2.31
November	0.84	1.94	2.87	1.62	0.44	5.90	1.61
December	0.40	1.39	1.08	0.42	1.65	1.47	1.02
Totals	**40.07**	**26.95**	**21.39**	**22.73**	**43.94**	**36.91**	**29.58**

Table 5. Monthly precipitation from the official weather station at Upham, N.D., for 1982-1987.

Month	1982	1983	1984	1985	1986	1987	Average
January	1.18	0.40	0.50	0.50	0.30	0.33	0.46
February	0.33	0.22	0.16	0.33	0.47	0.84	0.41
March	1.12	1.39	0.57	0.85	0.12	1.39	0.49
April	0.22	0.40	4.20	1.96	3.92	0.14	1.36
May	4.29	2.05	0.18	3.13	0.96	1.78	2.11
June	2.67	3.77	2.48	2.85	1.37	2.20	3.08
July	1.17	2.75	1.45	0.41	3.91	5.06	2.15
August	3.96	1.35	0.38	4.00	1.27	2.28	2.41
September	1.83	2.71	1.06	1.11	1.44	0.66	1.77
October	3.13	0.85	3.79	1.36	0.44	0.03	0.88
November	0.15	0.82	1.55	0.95	1.63	0.12	0.48
December	1.18	0.35	0.66	0.26	0.16	0.02	0.48
Totals	**21.23**	**17.06**	**16.98**	**17.71**	**15.99**	**14.85**	**16.08**

Table 6. Monthly precipitation from the official weather station at Fergus Falls, Minn., from 1982-1987.

Month	1982	1983	1984	1985	1986	1987	Average
January	0.54	0.19	0.32	0.30	0.40	0.73	0.84
February	0.51	0.31	0.60	0.12	0.44	0.65	0.62
March	1.10	1.44	0.66	0.72	0.80	1.74	1.05
April	0.61	0.35	2.20	0.74	4.38	0.39	2.37
May	2.69	0.81	0.81	6.90	2.77	4.11	2.74
June	2.40	4.40	9.52	2.91	3.70	0.72	4.36
July	2.86	3.90	0.80	4.41	5.01	3.08	3.21
August	4.10	3.38	2.11	3.40	4.57	2.05	3.01
September	2.08	2.18	1.16	1.75	6.56	1.08	2.09
October	3.95	0.95	6.33	1.05	0.13	0.61	1.45
November	0.48	1.20	0.06	1.36	0.95	0.61	0.96
December	0.26	0.45	0.46	0.71	0.04	0.55	0.82
Totals	**21.58**	**19.56**	**25.03**	**24.37**	**29.75**	**16.32**	**23.52**

Table 7. Monthly precipitation from the official weather station at Onida, S.D., from 1984-1989.

Month	1984	1985	1986	1987	1988	1989	Average
January	0.05	0.45	0.66	0.25	0.20	0.19	0.38
February	0.40	0.02	1.25	2.05	0.34	0.79	0.63
March	1.39	2.20	1.26	2.12	0.22	1.57	0.99
April	2.73	1.10	5.47	0.26	0.67	2.69	1.96
May	2.46	1.09	3.39	3.69	2.20	1.05	2.64
June	6.33	1.39	2.79	2.31	1.58	1.10	3.09
July	2.14	2.11	3.46	0.88	2.19	3.11	1.94
August	2.17	2.78	0.89	2.59	3.64	1.26	2.38
September	0.86	1.98	1.69	0.64	0.67	3.96	1.29
October	1.71	1.38	0.79	0.13	0.17	0.91	1.13
November	0.26	2.30	1.09	0.10	0.64	0.75	0.53
December	1.10	0.80	0.00	0.59	0.88	0.42	0.51
Totals	**21.60**	**17.60**	**22.74**	**15.61**	**13.40**	**17.80**	**17.47**

Table 8. Monthly precipitation from the official weather station at Lake Andes, S.D., from 1983-1988.

Month	1983	1984	1985	1986	1987	1988	Average
January	0.40	0.07	0.56	0.48	0.07	0.57	0.38
February	0.15	0.74	0.05	0.20	1.08	0.23	0.68
March	3.19	1.80	1.29	2.24	7.70	0.69	1.21
April	1.95	6.99	2.93	5.99	0.87	3.48	2.29
May	3.31	3.42	1.34	3.41	1.07	4.48	2.92
June	6.07	8.70	1.99	6.66	1.34	2.36	3.85
July	2.87	3.59	2.02	2.37	4.26	1.96	2.65
August	0.17	2.44	5.81	1.86	2.11	3.04	2.51
September	0.78	0.91	2.85	6.97	4.13	4.19	2.21
October	0.87	3.93	0.65	1.47	0.37	0.28	1.27
November	1.65	1.01	1.38	0.41	1.16	0.91	0.77
December	0.71	0.47	0.63	0.00	0.92	0.18	0.63
Totals	**22.20**	**34.27**	**21.16**	**32.06**	**25.08**	**22.37**	**21.37**

A plant hardiness zone recommendation is made for each release of the eight warm-season species contained in this publication. Use the plant hardiness map (Figure 2) and recommendations to determine which release will perform best at your location.

Herbage Production from the Growth Pattern and Nutritional Study (GPNS)

Switchgrass had the highest herbage production from the GPNS at both study areas in 1999 and 2000. When yearly differences occur within a grass variety, it is due to variability and timing of year-to-year precipitation. Dacotah switchgrass produced the greatest amount of herbage at Fort Pierre in 1999; however, Forestburg switchgrass produced the greatest amount of herbage at Fort Pierre and Hettinger in 2000 (Table 9).

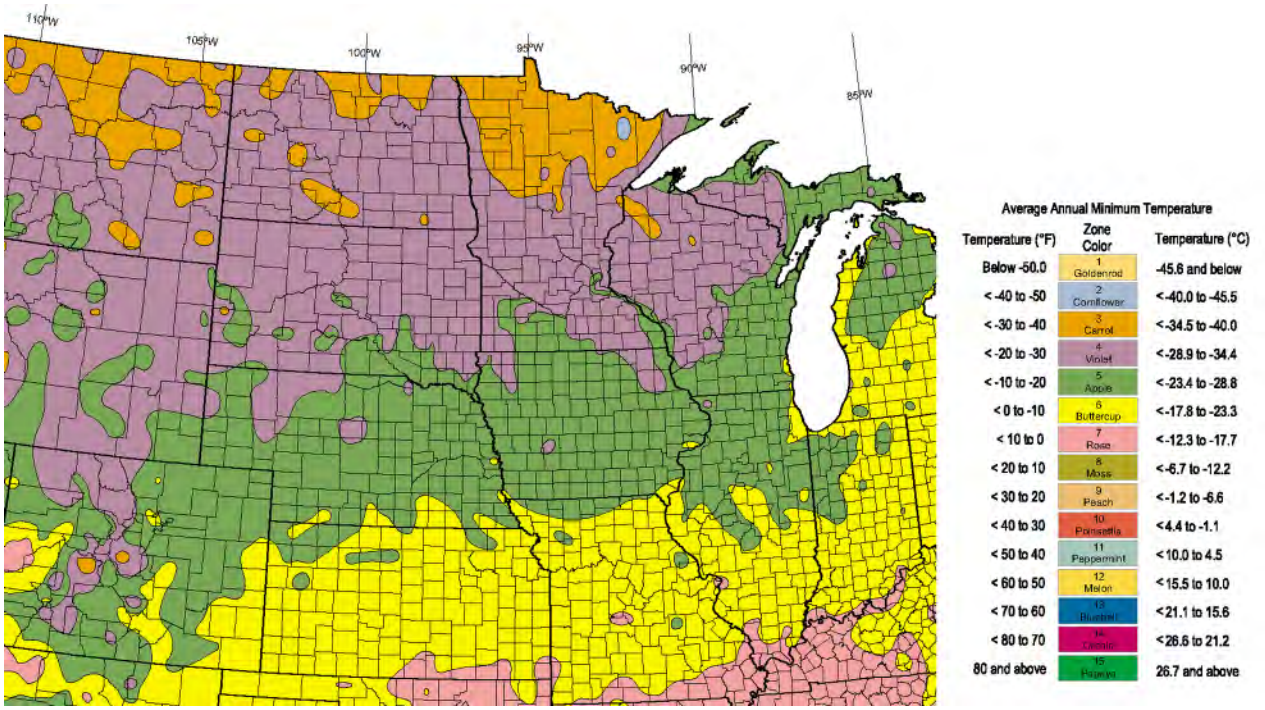


Figure 2. United States Department of Agriculture (1990) hardiness zones and average annual minimum temperature. (American Horticultural Society, Coordinated by Dr. H. Marc Cathey, President Emeritus, and USDA-ARS, Washington, D.C.)

Table 9. Cumulative herbage production (lb/ac) of selected warm-season grasses from the Growth Pattern and Nutritional Study near Hettinger, N.D., and Fort Pierre, S.D., in 1999-2000.

Species	Variety	Fort Pierre		Hettinger	
		1999	2000	2000	Mean
Switchgrass	Forestburg	2,992	5,343	5,447	4,594
Switchgrass	Dacotah	3,183	3,154	4,127	3,488
Big bluestem	Sunnyview	2,185	4,575	2,779	3,180
Big bluestem	Bison	2,412	3,894	3,165	3,157
Sand bluestem	Garden	—	—	3,755	3,755
Sand bluestem	Goldstrike	—	—	2,888	2,888
Blue grama	Bad River	—	—	2,714	2,714
Blue grama	Willis	—	—	2,640	2,640
Prairie sandreed	Bowman	3,208	3,809	2,076	3,031
Prairie sandreed	Goshen	1,613	3,083	1,529	2,075
Little bluestem	Camper	1,983	2,614	2,112	2,236
Little bluestem	Badlands	—	—	1,047	1,047
Indiangrass	Holt	1,903	2,261	—	2,082
Indiangrass	Tomahawk	2,059	1,729	—	1,894
Sideoats grama	Butte	376	252	3,921	1,516
Sideoats grama	Pierre	773	412	3,362	1,515

Switchgrass varieties differ in physical characteristics.

Field Evaluation for Plant Characteristics of the Original Study

Each accession/variety was evaluated for stand rating, stand density index, herbage production and phenology at Upham, N.D.; Fergus Falls, Minn.; Lake Andes, S.D.; Onida, S.D.; Rochester, Minn.; and Fort Pierre, S.D. Stand rating was conducted midsummer for a minimum of three years for each study area and rated 1 for excellent, 5 for fair and 9 for very poor. Stand density index (percent of full rows in sample frames where a "Full Frame = 40") was collected for two or more consecutive years at each field trial location in midsummer. Herbage production was clipped annually with a forage harvester at each field trial location at the end of the growing season (USDA NRCS 1983-1993). All samples were weighed with subsamples collected and oven dried at 140 F for 48 hours. Subsamples were weighed to the nearest 0.1 gram and converted to lb/ac. Plant maturity or phenology was determined in early September at all field trial locations except Upham, N.D., where phenology was determined in early August. Plant hardiness is listed for each variety and classified by zones in the introduction section for each species.

Plant Description, Growth Patterns, Nutritional Quality and Use Potential for the Growth Patterns and Nutritional Study (GPNS)

Selected warm-season grasses were analyzed for nutritional quality, herbage production and plant growth patterns at Hettinger, N.D., and Fort Pierre, S.D., in 1999 and 2000. Above-ground biomass were estimated for each variety by sampling approximately May 31, June 21, July 12, Aug. 1, Aug. 22, Sept. 12, and Oct. 3 in 1999 and 2000. Standing vegetation was clipped at 0.5 inch from ground level from each subplot of each variety using a 0.25 m^2 frame placed in a designated quadrant as randomly selected for each clipping period. Vegetation was placed into a paper bag with clipping date and physiological growth stage recorded at each clipping period. All samples were oven dried at 140° F until weight was constant and weighed to the nearest 0.1 gram.

Nutritional quality and herbage (forage) production were determined from unharvested, warm-season grass clippings at the seven periods throughout the growing season beginning in late May and ending in early October. Each of the grass varieties were tested for dry-matter, ash, crude protein (CP), acid detergent fiber (ADF), neutral detergent fiber (NDF), in vitro dry-matter digestibility (IVDMD), phosphorus and calcium. All samples were ground through a 1 mm screen in a Wiley mill and analyzed at the North Dakota State University Animal and Range Sciences nutritional laboratory. Dry matter, ash and ADF were determined following standardized procedures (AOAC 1990), NDF using procedures described by Robertson and Van Soest (1982) and CP using the Kjeldahl Auto System II (AOAC 1990). In vitro dry-matter digestibility was determined for each grass species using methods described by Tilley and Terry (1973). Herbage production was determined for each of the grass varieties for each clipping period to determine peak production and growth patterns.

Big Bluestem

Big bluestem (also known as "turkey foot") is a native, tall statured (36 to 60 inches tall), sod-forming, long-lived perennial grass that begins growth in late May and flowers in late July to mid-August. Big bluestem has scaly underground stems and an extensive root system that may reach to 12 feet in depth. Young shoots are somewhat flattened at the base, reddish to purplish tinged and usually covered with silky hairs. Leaves of mature, healthy big bluestem plants are large (¼ to ½ inch wide), numerous, and have coarse hairs. Plants remain green throughout the summer, turning red with maturity.

It is adapted to most loam, clay loam and sandy loam-textured soils but has a low tolerance to saline and/or sodic soils. Big bluestem was the dominant grass of the tallgrass prairie and still dominates the better managed tallgrass prairie remnants. In the mixed-grass prairie, big bluestem occurs as a minor component on loamy and clayey ecological sites and a co-dominant on the overflow (run-on landscape position) and subirrigated ecological sites. Big bluestem occurs in southern Canada and from Maine to Montana, south to Florida and New Mexico and into Mexico.

Big bluestem

Releases	Release Type	Date Released	Origin	Statement of Use
Boundary Ecovar	Source Identified	2009	Manitoba and easten Saskatchewan, Canada	Native collection of big bluestem with characteristics typical for that species in that area. Recommended in plant hardiness zones 3-4.
Bonanza	Variety	2005	ARS, Lincoln, Nebraska	Significantly greater forage digestibility than similarly adapted varieties Pawnee, Rountree and Niagara. Bonanza was developed from the base population of the cultivar Pawnee. Recommended in plant hardiness zone 4.
Goldmine	Variety	2005	ARS, Lincoln, Nebraska	Improved forage quality and forage yields in some hay management systems and improved animal gains in comparison with its parent variety, Kaw, when utilized by beef cattle in well-managed grazing systems. Higher forage yields and forage IVDMD than the varieties Pawnee, Rountree and Niagara reported in replicated trials. Recommended in plant hardiness zones 5-6.
Southlow Michigan Germplasm	Source Identified	2001	Michigan	Native harvest from the southern half of Michigan's Lower Peninsula. No intended selection. Material does not differ from naturally occurring big bluestem found in this area. Recommended in plant hardiness zones 4-5.
Northern Iowa Germplasm	Source Identified	2000	Iowa	Native harvest from multiple sites in northern Iowa. No intended selection for improvement. Recommended in plant hardiness zone 4.
Northern Missouri Germplasm	Source Identified	1999	Iowa	Native harvest from multiple sites in northern Missouri. No intended selection for improvement. Recommended in plant hardiness zone 5.
Southern Iowa Germplasm	Source Identified	1999	Iowa	Native harvest from multiple sites in southern Iowa. No intended selection for improvement. Recommended in plant hardiness zone 5.
Central Iowa Germplasm	Source Identified	1998	Iowa	Native harvest from multiple sites in central Iowa. No intended selection for improvement. Recommended in plant hardiness zones 4-5.
Sunnyview	Variety	1998	South Dakota	Selected for vigor, leafiness and seed yield. Sunnyview had the highest average forage yields at 5 of 6 replicated trials conducted in South Dakota, North Dakota and Minnesota. Later maturing than Bison and Bonilla and flowers about 12-25 days earlier than Pawnee and Kaw at Brookings, S.D. Recommended in plant hardiness zones 3-4.
Bison	Variety	1989	North Dakota	Selected for uniform plant type with good leafiness, high plant vigor, seed yields and winter hardiness. Bison is 20 days earlier in anthesis than the variety Bonilla and 30-48 days earlier than the southern varieties Kaw, Champ and Pawnee. Bison tends to be shorter in mature height. Recommended in plant hardiness zones 3-4.

Releases	Release Type	Date Released	Origin	Statement of Use
Bonilla	Variety	1987	South Dakota	Selected for high seed and forage yields and winter survival. Superior winter hardiness, persistence and seed production ability. Forage production exceeds that of Bison and is equal to Champ and Kaw at northern latitudes. Average daily gains of yearling steers have been higher for Bonilla than Pawnee in grazing studies at Morris, Minn. Recommended in plant hardiness zones 3-4.
Champ	Variety	1963	Nebraska	Moderately late maturing, averages 7-10 days earlier in seed maturity than Pawnee. Recommended in plant hardiness zones 4-5.
Rountree	Variety	1983	Iowa	Increased seedling vigor, increased leaf rust resistance, superior forage and seed production, and increased resistance to lodging. Recommended in plant hardiness zone 4.
Pawnee	Variety	1963	Nebraska	Typical of big bluestem of the central prairies. Produces good forage yields in Nebraska; superior to native strains originating farther north and west. Improved seed yields and seed quality. Recommended in plant hardiness zones 5-6.

Big Bluestem

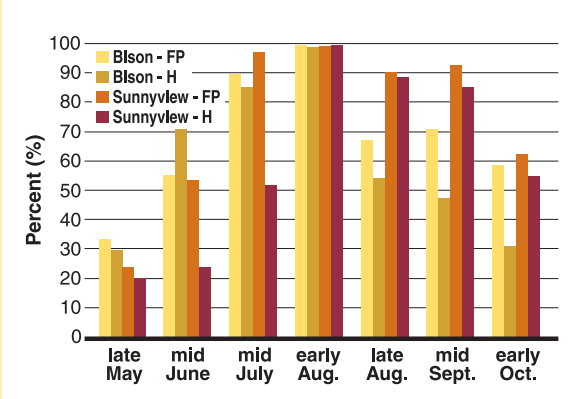
The NRCS recognizes four release types. These are variety (also commonly referred to as cultivar), tested, selected and source-identified. Variety, tested and selected release types have varying degrees of performance data collected for the release. Source-identified releases do not require performance documentation.

Performance Characteristics

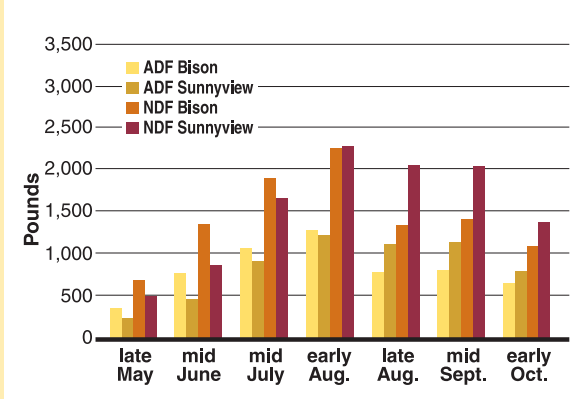
Big bluestem releases were studied for stand establishment and density index ratings (Table 10). The releases compared were Bison, Bonilla, Sunnyview, Rountree, Champ, Pawnee, and Kaw. Stand establishment ratings generally were good for all big bluestem entries across all sites. Stand ratings were similar for all releases, but variation occurred among sites. The big bluestem plots at Fort Pierre, S.D., had the lowest rated stands overall. This was the only site with heavy clay soils. The low-rated stands may have been related to soil crusting during seedling emergence. The plots at Upham, N.D., and Lake Andes, S.D., had the highest rated stands and also the most productive soils.

Bison and Bonilla were the two northern-most origin releases and generally were noted to have among the highest density index ratings. Stand index density was determined by estimating the number of plants in a 9-inch by 16-inch frame. The density index rating was developed with values ranging from 0 (no stand) to 40 (full stand) to estimate density. Values ranged from 23 to 30 for Bison and 21 to 39 for Bonilla. The lower density index ratings generally were associated with the more southern-origin releases. Comparing the six sites, Lake Andes, S.D., had the highest range of values (16 to 39) and Rochester, Minn., had the lowest (10 to 25). With the exception of Kaw, no specific damage caused by winter injury was noted for any of the big bluestem entries, including those of southern origin.

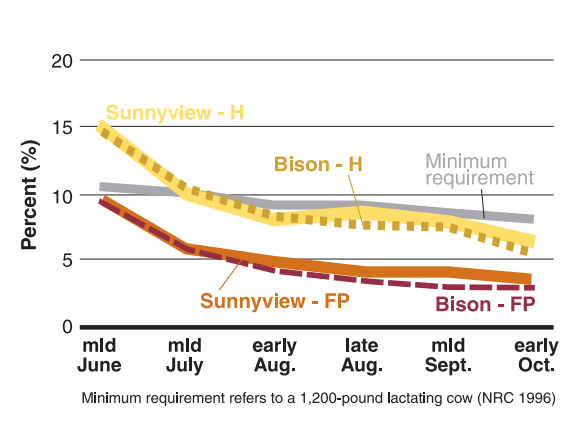
Big Bluestem



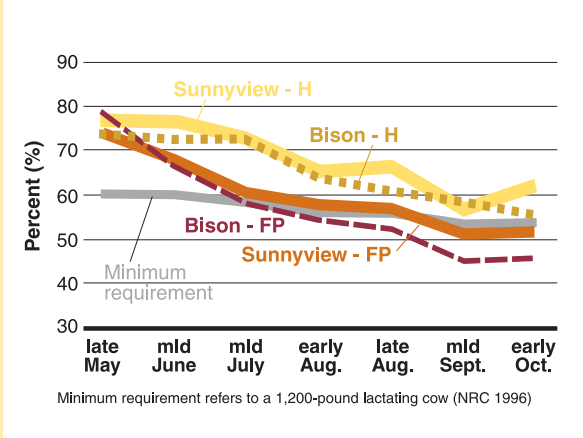
Percent of average peak standing biomass for big bluestem at Fort Pierre (FP) and Hettinger (H)



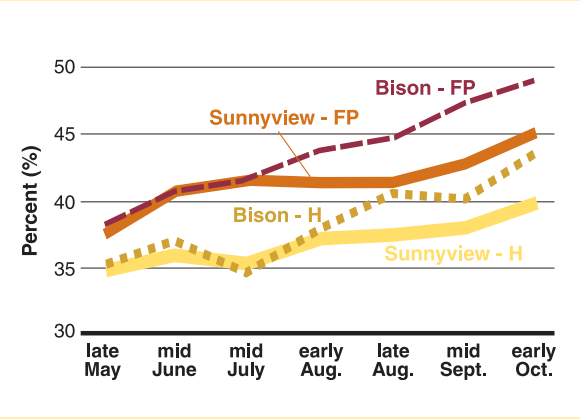
Pounds of acid detergent fiber and netural detergent fiber per acre for each period of big bluestem



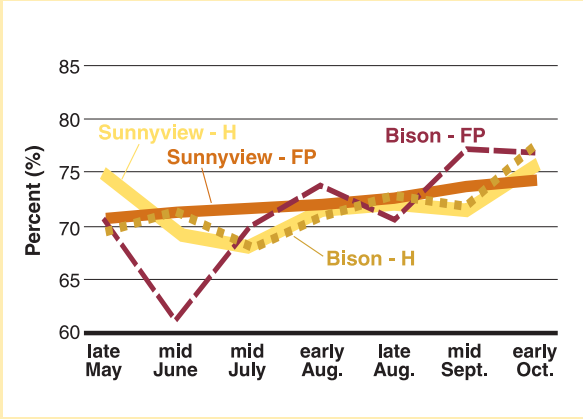
Crude protein content of big bluestem at Fort Pierre (FP) and Hettinger (H)



In vitro dry-matter digestibility of big bluestem at Fort Pierre (FP) and Hettinger (H)



Acid detergent fiber of big bluestem at Fort Pierre (FP) and Hettinger (H)



Neutral detergent fiber of big bluestem at Fort Pierre (FP) and Hettinger (H)

The varietal differences noted in phenology were similar at all six sites (Table 11). Bison had the earliest maturity. Generally, Bonilla was 15 to 30 days later than Bison. The other releases of big bluestem were later in maturity than Bison or Bonilla, but considerable variability occurred, depending on the site location. Kaw big bluestem had the latest maturity at all six sites and often had not reached anthesis by early September.

Herbage Production

Year and variety effects ($P<0.1$) occurred at all six sites during the six-year period in the original study. When creating an average biomass ranking across the six sites (1-7, with the lower number better), Sunnyview was the most productive variety with a rating of 1.5. Rankings from second through seventh were Pawnee (2.8), Kaw (2.8), Champ (3.2), Rountree (4.5), Bison (5.5) and Bonilla (5.8). Earlier-maturing, northern-origin varieties are less productive than later-maturing, southern-origin varieties (see Table 11 for biomass range, average and ranking for each variety and study area).

Cumulative herbage production from the GPNS for Bison was 2,412 and 3,894 lb/ac in 1999 and 2000, respectively, at Fort Pierre (Table 9). Sunnyview cumulative herbage production was 2,185 and 4,575 lb/ac in 1999 and 2000, respectively, at Fort Pierre. No difference ($P>0.1$) was found between varieties in 1999 and 2000 at both Hettinger and Fort Pierre. Mean herbage production was not different between Sunnyview and Bison (3,180 vs. 3,157 lb/ac) (Table 9). Although Sunnyview and Bison were similar in overall herbage production in the GPNS conducted at two sites for two years, Sunnyview was superior to all other varieties in the original study, which included six sites and five years.

Growth Patterns

Bison initiates greater growth in May and June than Sunnyview; however, both varieties reached peak herbage production in early August at both study sites. Sunnyview maintained more standing biomass than Bison through September and, depending on moisture, had less senescence and greater regrowth.

Nutritional Quality

Location was more critical in crude protein (CP) and in vitro dry-matter digestibility (IVDMD) than variety in the GPNS. Nutritional quality (CP, IVDMD) was similar between Bison and Sunnyview at both study locations (Hettinger and Fort Pierre); however, Fort Pierre had

Table 10. Big bluestem stand rating (1-9)[a] and density index (0-40)[b] at Upham, N.D.; Fergus Falls and Rochester, Minn.; Onida, Fort Pierre and Lake Andes, S.D.

Varieties	Performance	Upham	Fergus Falls	Rochester	Onida	Fort Pierre	Lake Andes
Bison	Stand Rating	1	2.3	3.0	2.3	2.9	2.5
	Density Index	30	23	23	28	28	27
Bonilla	Stand Rating	1.3	2.6	2.5	2.5	3.8	2.1
	Density Index	32	25	21	26	23	39
Sunnyview	Stand Rating	1	3.3	2.4	2.9	4.5	1.8
	Density Index	25	20	10	25	16	24
Rountree	Stand Rating	NA	NA	2.6	3.5	3.1	3.0
	Density Index			25	21	26	16
Champ	Stand Rating	1.4	3.6	2.3	3.0	3.6	1.6
	Density Index	21	14	25	25	28	28
Pawnee	Stand Rating	1.2	2.7	2.3	2.8	2.3	1.7
	Density Index	26	21	22	30	30	20
Kaw	Stand Rating	1.3	2.6	3.9	3.5	4.2	1.6
	Density Index	18	21	18	24	22	28

[a]Stand rating: 1 = highest, 9 = lowest.
[b]Density index: estimate of plant density, 40 = highest.

CP levels 3 percent to 5 percent lower than Hettinger throughout the growing season. The IVDMD also was similar between varieties, with initial quality similar between Fort Pierre and Hettinger; however, it was 11 percent lower by early October.

Big bluestem is nutritional and palatable for all classes of livestock from June through late August. The CP content drops below 10 percent by early July to early August, depending on location. Crude protein content was below 5 percent by early August at Fort Pierre and early October at Hettinger. In vitro dry-matter digestibility of big bluestem was below 55 percent by late August at Fort Pierre and early October in Hettinger.

Fiber Content

Fiber content of big bluestem was lowest at the immature growth stage (early May), increasing through maturation and peaking at the end of the growing season. Acid detergent (ADF) and neutral detergent fiber (NDF) increased linearly throughout the growing season, with ADF peaking at 43 percent and 47 percent by early October for Sunnyview and Bison, respectively. Neutral detergent fiber increased from 70 percent to 75 percent in early May to 74 percent to 77 percent in early October.

Sunnyview ranked fourth and Bison fifth out of the 16 warm-season grass varieties studied in terms of average pounds of ADF and NDF produced per acre during

Table 11. Big bluestem biomass (lb/ac) range and average, mean biomass rank and phenology (1-9)[a] in early September (early August for Upham) at Upham, N.D.; Fergus Falls and Rochester, Minn.; Onida, Fort Pierre and Lake Andes, S.D.

Varieties	Performance	Upham	Fergus Falls	Rochester	Onida	Fort Pierre	Lake Andes
Bison	Biomass Range	5,410 – 9,426	1,298 – 4,139	1,255 – 2,595	405 – 3,120	87 – 4,159	2,272 – 5,338
	Biomass Average	5,093	2,878	1,944	1,586	1,528	3,836
	Biomass Rank	2	6	6	6	7	6
	Phenology	7	6	6	8	7	6
Bonilla	Biomass Range	1,796 – 6,471	2,055 – 5,058	461 – 3,164	392 – 4,625	93 – 3,680	2,125 – 5,536
	Biomass Average	4,264	3,869	1,803	1,949	1,728	3,477
	Biomass Rank	6	4	7	5	6	7
	Phenology		5	6	6	6	6
Sunnyview	Biomass Range	2,469 – 7,981	3,439 – 6,623	1,844 – 5,878	699 – 5,913	322 – 4,611	4,200 – 7,809
	Biomass Average	5,988	5,022	3,346	2,255	2,143	5,317
	Biomass Rank	1	1	2	2	2	1
	Phenology	5	4	5	6	4	5
Rountree	Biomass Range	NA	NA	1,204 – 4,354	905 – 4,897	194 – 4,296	3,426 – 7,657
	Biomass Average	NA	NA	2,381	1,970	1,877	4,683
	Biomass Rank	NA	NA	5	4	5	4
	Phenology	NA	NA	4	5	4	5
Champ	Biomass Range	3,403 – 6,719	2,129 – 4,813	1,313 – 5,543	826 – 5,222	152 – 5,030	4,114 – 5,745
	Biomass Average	4,918	4,029	2,974	2,134	2,007	4,899
	Biomass Rank	3	3	3	3	4	3
	Phenology	5	4	5	5	4	5
Pawnee	Biomass Range	1,997 – 5,877	2,141 – 5,591	2,048 – 5,508	1,556 – 7,271	235 – 4,964	2,810 – 5,928
	Biomass Average	4,508	4,207	3,377	3,029	2,121	4,073
	Biomass Rank	5	2	1	1	3	5
	Phenology	3	3	4	4	2	5
Kaw	Biomass Range	2,752 – 6,189	1,629 – 4,673	1,575 – 4,982	540 – 7,597	297 – 4,968	3,846 – 7,796
	Biomass Average	4,916	3,21	2 2,887	3,029	2,186	5,273
	Biomass Rank	4	5	4	1	1	2
	Phenology	1	2	4	4	1	5

[a]Phenology: 1 = vegetative; 2 = jointing; 3 = first emergence of inflorescence; 4 = first anthesis, 10 culms or more; 5 = 50% anthesis; 6 = first seed ripe; 7 = 50% seed ripe; 8 = seed mature; 9 = complete dormancy.

the two-year period. Harvesting maximum levels of ADF and NDF of Sunnyview occurred in early August, with 1,240 and 2,290 lb/ac of ADF and NDF, respectively. Harvesting maximum levels of ADF and NDF of Bison also occurred in early August, with 1,294 and 2,273 lb/ac of ADF and NDF, respectively.

Grazing Value

Big bluestem will provide good grazing from June through September and is considered a highly palatable warm-season grass. With proper grazing management, big bluestem can withstand substantial grazing, but close grazing can decrease the stand. A stubble height of 6 inches is recommended to assure stand longevity. Bison is the earliest maturing variety, with grazing recommended from late June, when grasses reach a height of 8 to 14 inches, through early September. Bonilla matures about 10 days later and Rountree, Champ and Pawnee about 25 to 30 days later than Bison and is recommended for grazing from early July through early September. Kaw generally is not recommended for grazing in the northern Plains. When comparing growth patterns and nutritional value, livestock grazing from mid-June through early August will optimize forage use and nutrient content. In vitro dry-matter digestibility was difficult to interpret but appears to be adequate through late August. A rotational grazing system can extend immature plant growth through early September, reduce trampling loss, enhance utilization, and increase nutritional quality and palatability.

From a forage management standpoint, big bluestem should be established as a pure stand for pasture development. Recommended varieties for livestock grazing in North and South Dakota and northern Minnesota are Bison, Bonilla and Sunnyview. Recommendations for Nebraska, Iowa, southern Minnesota and southern South Dakota include Rountree, Champ, Sunnyview and Pawnee.

Recommended Grazing Season:
late June to early September (depending on variety).

Hay Value

Big bluestem can make good hay, depending on timing of harvest and variety. It is palatable when immature; however, it becomes less desirable once maturation occurs and fiber increases. The proper harvest technique for optimum stand maintenance would be to leave a stubble height of 6 inches and achieve adequate regrowth (about 10 inches) prior to the first killing frost.

Big bluestem should be cut by the early boot to boot growth stage to maintain good CP (9 percent to 10 percent) and IVDMD (> 55 percent) for winter feed and at flowering to maintain a CP and IVDMD level for nonlactating animals.

Recommended varieties for hay production in North and South Dakota and northern Minnesota are Bison, Bonilla and Sunnyview. Recommendations for Nebraska, Iowa, southern Minnesota and southern South Dakota include Rountree, Champ, Sunnyview and Pawnee.

Recommended Haying Time:
late July to early August for a nonlactating ration that achieves a maintenance quality with optimum forage production and late June to early July for lactating ration, optimum quality and lower production (variety dependent).

Wildlife Value

Birds and mammals use big bluestem for nesting and escape cover in summer and winter. It resists lodging under snow cover almost as well as switchgrass, thereby contributing to spring nesting habitat and winter thermal cover. Seeds are eaten by birds, especially in winter, while hoofed browsers, such as antelope, bison and white-tailed deer, eat the vegetative parts of the plant. Big bluestem is an important host for butterflies, including the regal fritillary.

Big bluestem should be seeded in a mixture with other native grasses, forbs and legumes to provide structure of various heights as habitat for grassland nesting birds and other wildlife species. Without proper management, cool-season invasive species (Kentucky bluegrass and smooth bromegrass) will become competitive, reducing habitat quality.

Cover Value	
Spring:	Good
Summer:	Excellent
Fall:	Excellent
Winter:	Good

Forage Value	
Spring:	Good
Summer:	Good
Fall:	Fair
Winter:	Poor

Big bluestem provides high-quality forage during summer months. (Photo by Paul Nyren, NDSU)

Little Bluestem

Little bluestem is a native, midstatured (18 to 36 inches tall) perennial bunchgrass with a dense root system that may reach 5 to 8 feet in depth. Growth begins in mid-May, with seed stalks appearing from late July to August. Little bluestem can reproduce by seed or vegetatively via short underground rootstocks. Young tillers are distinctively flattened at the base, with the mature plants acquiring a reddish color late in the growing season. This color becomes very distinctive in the fall, with entire hillsides taking on a reddish hue when occupied by little bluestem.

Little bluestem is adapted to a wide range of soil textures. On rangeland, it generally is associated with dry, upland sites with soils high in calcium carbonate, such as thin loamy and limy sands ecological sites. However, little bluestem also is found on wetter sites with similar soil chemistry, such as the limy subirrigated ecological site. Little bluestem is found in southern Canada, Maine to Idaho, south to Florida and Arizona and into Mexico.

Little bluestem

Releases	Release Type	Date Released	Origin	Statement of Use
Spirit Ecovar	Source Identified	2003	Alberta and Saskatchewan, Canada	Native collection of little bluestem with characteristics typical for the species in that area. Recommended for plantings in areas receiving 10″ to 12″ of annual precipitation. Recommended in plant hardiness zone 3.
Southlow Michigan Germplasm	Source Identified	2001	Michigan	Native harvest from the southern half of Michigan's Lower Peninsula. No intended selection. Material does not differ from naturally occurring little bluestem found in this area. Recommended in plant hardiness zones 4-5.
Itasca Germplasm	Selected	2001	North Dakota, South Dakota, Minnesota	Selected for improved vigor, leafiness and disease resistance. Broad genetic base with phenology varying up to two weeks. Plant maturity is approximately 4 weeks earlier than Blaze and Camper. Recommended in plant hardiness zones 3-4.
Taylor Ecovar	Selected	2000	Manitoba and Saskatchewan, Canada	Recommended for planting in areas receiving 18″ to 22″ of annual precipitation. Recommended in plant hardiness zone 3.
Southern Iowa Germplasm	Source Identified	1999	Iowa	Native harvest from multiple sites in southern Iowa. No intended selection for improvement. Recommended in plant hardiness zone 5.
Northern Iowa Germplasm	Source Identified	1999	Iowa	Native harvest from multiple sites in northern Iowa. No intended selection for improvement. Recommended in plant hardiness zone 4.
Northern Missouri Germplasm	Source Identified	1999	Iowa	Native harvest from multiple sites in northern Missouri. No intended selection for improvement. Recommended in plant hardiness zones 5-6.
Central Iowa Germplasm	Source Identified	1997	Iowa	Native harvest from multiple sites in central Iowa. No intended selection for improvement. Recommended in plant hardiness zones 4-5.
Badlands Ecotype	Selected	1996	North Dakota, South Dakota	Broad genetic base with improved plant vigor, seed production and disease resistance. Phenology may vary up to two weeks within the population. Approximately 4 weeks earlier in maturity than Blaze or Camper. Recommended in plant hardiness zones 3-4.
Cimarron	Variety	1979	Kansas, Oklahoma	Selected for improved forage production and disease resistance. Recommended in plant hardiness zones 4-5.
Camper	Variety	1973	Nebraska, Kansas	Broad genetic composition, adaptation, seed production and stand establishment compared with native harvested material. Recommended in plant hardiness zone 4.
Blaze	Variety	1967	Nebraska, Kansas	Leafy, mid-tall and late maturing in central latitudes. Foliage is bright to dull green, turning red in the fall. The area of reliable seed production is centered in southeast Nebraska. Recommended in plant hardiness zone 4.

Releases	Release Type	Date Released	Origin	Statement of Use
Aldous	Variety	1966	Kansas, Oklahoma	Tall, leafy and vigorous, medium late in maturity. Produces abundant forage and, under favorable conditions, good seed yield. Has some resistance to rust. Recommended in plant hardiness zones 4-5.

Little Bluestem

The NRCS recognizes four release types. These are variety (also commonly referred to as cultivar), tested, selected and source identified. Variety, tested and selected release types have varying degrees of performance data collected for the release. Source-identified releases do not require performance documentation.

Performance Characteristics

Little bluestem releases were studied for stand establishment and density index ratings in the original study (Table 12). The releases compared were Blaze, Camper, Aldous, and Cimarron. Badlands is a newer release and was available only for planting at the Hettinger, N.D., GNPS plots. Blaze and Camper had better stand ratings compared with Cimarron and Aldous at Upham, N.D., and Fergus Falls, Minn., the two northern-most plot locations. This also was true for the stand density index ratings. Aldous and Camper had the best stand ratings and densities at Lake Andes, S.D. Winter injury was noted for Aldous and Cimarron at the northern-most site at Upham.

Phenology was somewhat variable among sites, but generally Blaze and Camper were earlier maturing than Aldous and Cimarron (Table 13). Mature seed was not produced at any of the six site locations by early September for any of the four releases.

Herbage Production

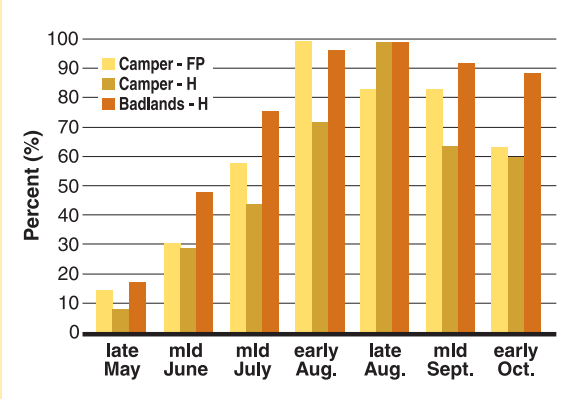
Location effects ($P<0.1$) occurred for the six sites in the original study. When creating an average biomass ranking across the six sites (1-4, with the lower number better), Cimarron was the most productive variety with a rating of 2.0. Rankings from second through fourth were

Table 12. Little bluestem stand rating (1-9)[a] and density index (0-40)[b] at Upham, N.D.; Fergus Falls and Rochester, Minn.; Onida, Fort Pierre and Lake Andes, S.D.

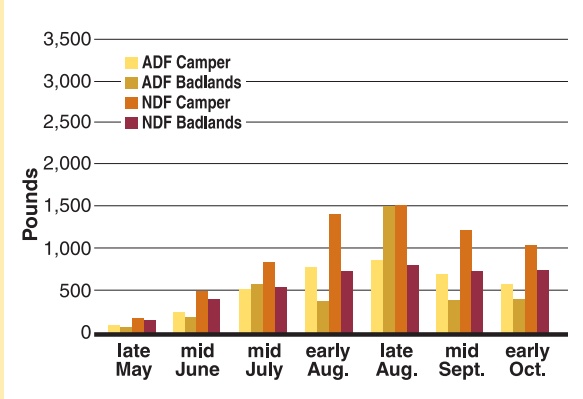
Varieties	Category	Upham	Fergus Falls	Rochester	Onida	Fort Pierre	Lake Andes
Blaze	Stand Rating	1.6	3.6	4.4	3.2	4.3	3.4
	Density Index	23	16	10	19	20	18
Camper	Stand Rating	1.1	4.2	3.8	2.7	5.7	1.9
	Density Index	23	20	15	20	14	26
Aldous	Stand Rating	2.9	4.2	4.7	2.9	4.4	2.4
	Density Index	12	11	9	18	18	17
Cimarron	Stand Rating	3.4	3.8	4.0	2.6	5.0	1.6
	Density Index	15	11	13	16	17	26

[a]Stand rating: 1 highest, 9 lowest.
[b]Density index: estimate of plant density, 40 = highest.

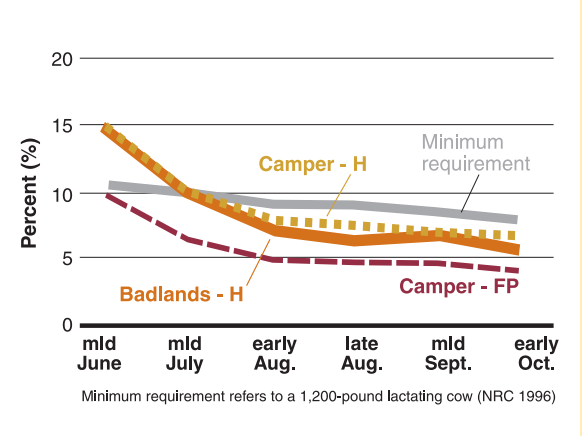
Little Bluestem



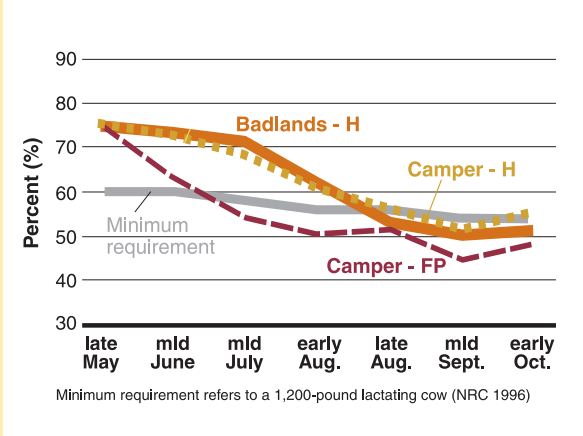
Percent of average peak standing biomass for little bluestem at Fort Pierre (FP) and Hettinger (H)



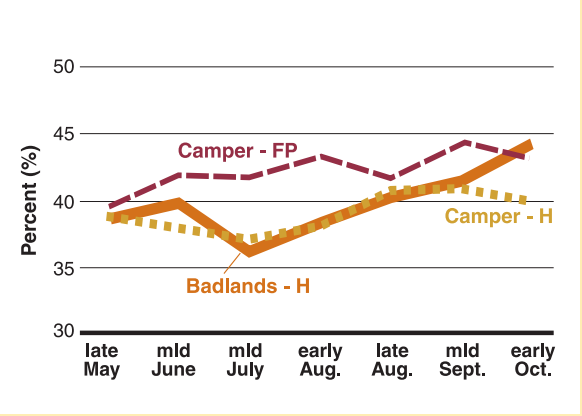
Pounds of acid detergent fiber and netural detergent fiber per acre for each period of little bluestem



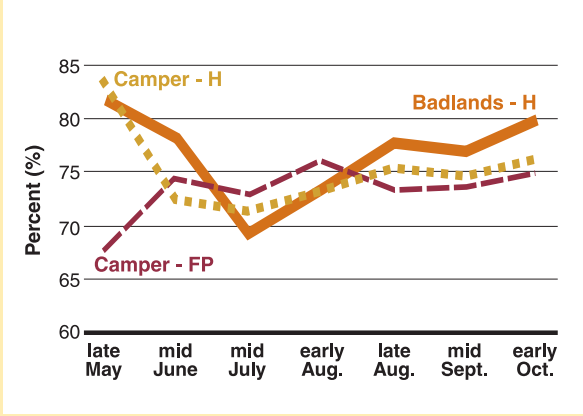
Crude protein content of little bluestem at Fort Pierre (FP) and Hettinger (H)



In vitro dry-matter digestibility of little bluestem at Fort Pierre (FP) and Hettinger (H)



Acid detergent fiber of little bluestem at Fort Pierre (FP) and Hettinger (H)



Neutral detergent fiber of little bluestem at Fort Pierre (FP) and Hettinger (H)

Aldous (2.2), Blaze (2.8) and Camper (3.0). Earlier-maturing, northern-origin varieties are less productive than later-maturing, southern-origin varieties (See Table 13 for biomass range, average and ranking for each variety and study area).

Cumulative herbage production from the GPNS for Camper was 1,983 and 2,614 lb/ac in 1999 and 2000, respectively, at Fort Pierre, S.D., and 2,112 lb/ac at Hettinger in 2000 (Table 9). Badlands was studied in this trial only at Hettinger, yielding 1,047 lb/ac in 2000. Mean herbage production for Camper was greater than Badlands (2,236 vs. 1,047) in the GPNS.

Growth Patterns

Badlands grows faster than Camper in June and July, with both varieties reaching peak standing crop in early to late August in the GPNS. Badlands senesces slower than Camper in September and October, with neither species achieving significant regrowth following peak production.

Nutritional Quality

Location was more critical in crude protein (CP) and in vitro dry-matter digestibility (IVDMD) than variety in the GPNS. Nutritional quality (CP, IVDMD) was similar between Badlands and Camper at both study locations (Hettinger and Fort Pierre); however, Fort Pierre had CP levels 3 percent to 5 percent lower than Hettinger through the growing season. The IVDMD also was similar between varieties, with initial quality similar between locations; however, it was 15 percent lower in mid-July and similar by early October.

Little bluestem in the immature growth phase is considered a nutritional, palatable grass for all classes of livestock in June and early July. The CP content drops below 10 percent by mid-July. Crude protein content was below 5 percent at Fort Pierre and about 6 percent at Hettinger in early October when fully mature. In vitro dry-matter digestibility of little bluestem was below 55 percent by early July at Fort Pierre and late August at Hettinger.

Table 13. Little bluestem biomass (lb/ac) range and average, mean biomass rank and phenology (1-9)[a] in early September (early August for Upham) at Upham, N.D.; Fergus Falls and Rochester, Minn.; Onida, Fort Pierre and Lake Andes, S.D.

Varieties	Performance	Upham	Fergus Falls	Rochester	Onida	Fort Pierre	Lake Andes
Blaze	Biomass Range	2,163 – 3,701	2,010 – 5,249	776 – 6,428	1,272 – 5,166	192 – 4,224	1,617 – 5,384
	Biomass Average	3,111	3,446	2,624	2,855	1,710	3,945
	Biomass Rank	2	3	3	1	4	4
	Phenology	3	3	4	4	4	4
Camper	Biomass Range	2,546 – 5,231	1,732 – 3,978	1,258 – 5,656	284 – 5,773	120 – 4,798	3,747 – 6,795
	Biomass Average	3,977	2,610	2,505	2,013	1,892	4,500
	Biomass Rank	1	4	4	4	2	3
	Phenology	4	3	4	5	4	5
Aldous	Biomass Range	1,215 – 4,496	2,997 – 5,299	1,228 – 6,820	590 – 5,171	210 – 4,384	3,753 – 7,573
	Biomass Average	3,051	4,034	3,117	2,103	1,777	5,300
	Biomass Rank	3	1	1	3	3	2
	Phenology	3	1	4	3	3	4
Cimarron	Biomass Range	1,330 – 4,061	2,742 – 4,654	993 – 6,855	410 – 5,487	147 – 5,254	3,732 – 8,752
	Biomass Average	2,971	3,477	2,652	2,802	1,921	5,345
	Biomass Rank	4	2	2	2	1	1
	Phenology	2	1	3	4	3	4

[a]Phenology: 1 = vegetative; 2 = jointing; 3 = first emergence of inflorescence; 4 = first anthesis, 10 culms or more; 5 = 50% anthesis; 6 = first seed ripe; 7 = 50% seed ripe; 8 = seed mature; 9 = complete dormancy.

Fiber Content

Fiber content of little bluestem was lowest at the immature growth stage (early May), increasing through maturation and peaking at the end of the growing season. Acid detergent (ADF) and neutral detergent fiber (NDF) increased linearly throughout the growing season, with ADF peaking at 42 percent and 43 percent by early October for Camper and Badlands, respectively. Neutral detergent fiber was highest in early October at 75 percent and 80 percent for Badlands and Camper, respectively.

Camper ranked 12th and Badlands 16th out of the 16 warm-season grass varieties studied in terms of average pounds of ADF and NDF produced per acre during the two-year period. Harvesting maximum levels of ADF and NDF of Camper occurred in late August, with 869 and 1,531 lb/ac of ADF and NDF, respectively. Harvesting maximum levels of ADF and NDF of Badlands occurs in late August, with 424 and 811 lb/ac of ADF and NDF, respectively.

Grazing Value

Little bluestem will provide good grazing from mid-June through early July; however, palatability is lower than in many other native warm-season grasses, especially when seed stalks are present. Proper grazing management is critical to improve grazing efficiency. Higher stock densities such as seen in rotational grazing systems will achieve greater use of more plants. Recommended stubble height of 3 to 4 inches is required to assure stand longevity.

Spirit, Taylor, Badlands and Itasca are the earliest-maturing releases, with grazing recommended from mid-June through late July. Camper and Blaze are 20 to 30 days later maturing and recommended for grazing from early July through August. Cimarron and Aldous are 20 to 30 days later maturing than Camper and Blaze. A rotational grazing system can extend immature plant growth through early September, increasing nutritional quality and palatability.

Little bluestem planted for pasture should be established with other native range species. Recommended varieties/releases for livestock grazing in North Dakota and northern Minnesota are Badlands, Itasca and Taylor. Recommendations for South Dakota and southern Minnesota include Badlands, Camper and Blaze. Recommendations for Nebraska and Kansas include Camper, Blaze, Aldous, and Cimarron. The remaining germplasm releases are more local and recommended for the regions from which they originated.

Recommended Grazing Season:
mid-June to early September (depending on variety).

Hay Value

Although not usually recommended for hay production, little bluestem can make fair to good hay when part of a native hay land mixture. It is palatable when immature; however, it becomes less desirable once maturation occurs and seed stalks are present. If establishing little bluestem as forage, grazing would be recommended, with hay use the alternative option. Haying and burning to remove mature growth are viable options to improve palatability. Proper harvest technique is required by achieving a stubble height of 4 inches to assure stand longevity.

Suitable varieties/releases for hay production in North Dakota and northern Minnesota are Badlands, Itasca and Taylor. Recommendations for South Dakota and southern Minnesota include Badlands, Camper and Blaze. Recommendations for Nebraska and Kansas include Camper, Blaze, Aldous, and Cimarron. The remaining germplasm releases are more local and recommended for the regions from which they originated.

Recommended Haying Time:
mid to late July for a nonlactating ration that achieves a maintenance quality with optimum forage production and early July to mid-July for lactating ration, optimum quality and lower production (variety dependant).

Wildlife Value

Little bluestem seed is eaten by songbirds and upland game birds. It is grazed by antelope. The plant provides nesting cover for various grassland nesting birds, including meadowlarks and songbirds. Sharp-tailed grouse use little bluestem for loafing cover. Dakota skipper butterfly larvae prefer little bluestem as a food source. Small mammals will use the seeds and leaves for food.

Little bluestem should be seeded in a mixture with other native grasses, forbs and legumes to provide structure of various heights as habitat for grassland nesting birds and other wildlife species. Without proper management, cool-season invasive species (Kentucky bluegrass and smooth bromegrass) will become competitive, reducing habitat quality.

Cover Value
Spring: Good
Summer: Good
Fall: Good
Winter: Fair

Forage Value
Spring: Fair
Summer: Good
Fall: Poor
Winter: Fair

Seed production field of little bluestem.

Sand Bluestem

Sand bluestem is a native, tall statured (36 to 60 inches tall), sod-forming perennial grass that reproduces from seed and scaly rhizomes. It begins growth in early May and flowers in late July, with seed produced in August to October on tillers that are from 3 to 6 feet in height. Sand bluestem is similar in appearance to big bluestem but tends to be more bluish or grayish, has a J-shaped stem base and produces seed heads that have a dense covering of yellow hairs. Sand bluestem is more prominently rhizomatous and more drought tolerant than big bluestem. Big and sand bluestems have been known to hybridize.

Sand bluestem tends to grow in colonies, preferring drier sites with sandy, sand or coarse sand-textured soils. This would include such ecological sites as sands, choppy sands and thin sands. Sand bluestem occurs naturally from the eastern Dakotas west to Montana south to Iowa, Texas and Arizona.

Sand bluestem

Releases	Release Type	Date Released	Origin	Statement of Use
Cherry	Variety	1961	Nebraska	Typical of sand bluestem. Recommended in plant hardiness zones 3-4.
Garden	Variety	1960	Nebraska	Vigorous, tall, leafy variety. Good seed yields. Adapted throughout the sandhills of Nebraska and South Dakota. Recommended in plant hardiness zone 4.
Goldstrike	Variety	1953	Nebraska, Oklahoma	Typical of sand bluestem. Plants are variable in height. Recommended in plant hardiness zones 4-5.

Sand Bluestem

The NRCS recognizes four release types. These are variety (also commonly referred to as cultivar), tested, selected and source identified. Variety, tested and selected release types have varying degrees of performance data collected for the release. Source-identified releases do not require performance documentation.

Performance Characteristics

Sand bluestem releases were studied for stand establishment and density index ratings (Table 14). The releases compared were Goldstrike and Garden. Stand establishment ratings were good for both sand bluestem entries across all sites. Stand ratings were similar for both releases, but variation occurred among sites. The plots at Upham, N.D., had the highest rated stands and also one of the most productive soils.

Stand index density was determined by estimating the number of plants in a 9-inch by 16-inch frame. The density index rating was developed with values ranging from 0 (no stand) to 40 (full stand) to estimate density. Values ranged from 16 to 32 for Goldstrike and 15 to 28 for Garden. Comparing the six sites, Upham, N.D., had the highest value (28) and Lake Andes, S.D., had the lowest (15 to 16). Overall, both releases established readily and achieved good stands. No specific damage caused by winter injury was noted for either of the sand bluestems.

Phenology of the two releases compared was the same at each site and was similar to the releases of other warm-season species originating from the central Plains (Table 15). Average maturity was first anthesis in early September, and hard seed was produced minimally toward the end of the growing season at Onida, Fort Pierre and Rochester.

Herbage Production

Year and variety effects ($P<0.1$) occurred at all six sites during the six-year period in the original study. When creating an average biomass ranking across the six sites (1-2, with the lower number better), Garden was the most productive variety with a rating of 1.2 and Goldstrike second in production at 1.8 (see Table 15 for biomass range, average and ranking for each variety and study area).

Cumulative herbage production from the GPNS for Garden and Goldstrike was 3,755 and 2,888 lb/ac, respectively, at Hettinger in 2000 (Table 9). No difference ($P>0.1$) was found between varieties at the Hettinger study site. Sand bluestem releases were not sampled for herbage production at Fort Pierre in the GPNS due to declining stands.

Growth Patterns

Garden and Goldstrike have similar growth patterns, with both varieties achieving peak herbage production in mid-September. Based on the GPNS, Garden senesced quicker than Goldstrike in October, probably explaining why Garden has better stand longevity, as noted in the original study.

Nutritional Quality

Nutritional quality (CP, IVDMD) was similar between Goldstrike and Garden at Hettinger. Sand bluestem is nutritional and palatable for all classes of livestock from June through late August, with palatability slightly lower than big bluestem. The CP content drops below 10 percent by early August. Crude protein content was maintained above 5 percent through early October at Hettinger. In vitro dry-matter digestibility of sand bluestem was above 60 percent through early October in Hettinger.

Fiber Content

Fiber content of sand bluestem was lowest at the immature growth stage (early May through mid-July), slightly increasing through maturation and peaking at the end of the growing season. Neutral detergent fiber (NDF) increased linearly throughout the growing season. ADF peaked at 39 percent by early October for both releases. Neutral detergent fiber increased from 66 percent in late June to 75 percent to 76 percent in early October.

Garden ranked third and Goldstrike eighth out of the 16 warm-season grass varieties studied in terms of average pounds of ADF and NDF produced per acre during the two-year period. Harvesting maximum levels of ADF and NDF of Garden occurred in mid-September, with 1,389 and 2,697 lb/ac of ADF and NDF, respectively. Harvesting maximum levels of ADF and NDF of Goldstrike occurred from late August through mid-September, with 1,072 and 2,030 lb/ac of ADF and NDF, respectively.

Table 14. Sand bluestem stand rating (1-9)[a] and density index (0-40)[b] at Upham, N.D.; Fergus Falls and Rochester, Minn.; Onida, Fort Pierre and Lake Andes, S.D.

Varieties	Category	Upham	Fergus Falls	Rochester	Onida	Fort Pierre	Lake Andes
Goldstrike	Stand Rating	1.2	4.0	3.1	3.2	3.3	2.9
	Density Index	28	16	23	32	27	16
Garden	Stand Rating	1.0	3.1	3.1	2.5	4.2	3.0
	Density Index	28	19	23	28	20	15

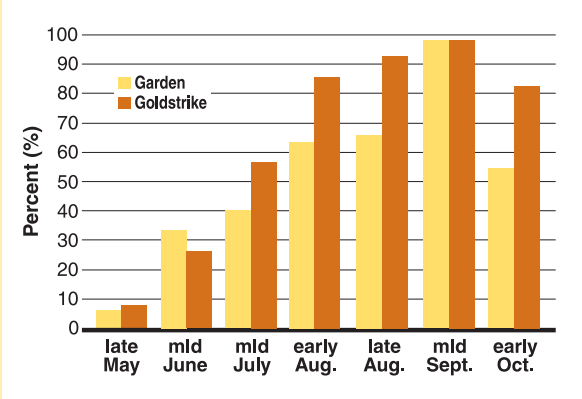
[a]Stand rating: 1 = highest, 9 = lowest.
[b]Density index: estimate of plant density, 40 = highest.

Table 15. Sand bluestem biomass (lb/ac) range and average, mean biomass rank and phenology (1-9)[a] in early September (early August for Upham) at Upham, N.D.; Fergus Falls and Rochester, Minn.; Onida, Fort Pierre and Lake Andes, S.D.

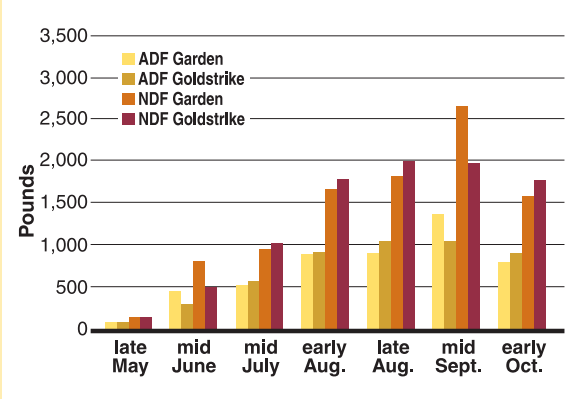
Varieties	Performance	Upham	Fergus Falls	Rochester	Onida	Fort Pierre	Lake Andes
Goldstrike	Biomass Range	3,357 – 6,324	1,325 – 5,347	807 – 3,419	669 – 5,332	136 – 3,694	2,702 – 7,219
	Biomass Average	4,732	2,924	1,586	2,095	1,497	4,146
	Biomass Rank	2	1	2	2	2	2
	Phenology	5	4	5	7	5	5
Garden	Biomass Range	3,705 – 7,855	2,609 – 4,454	2,296 – 4,820	1,290 – 6,861	191 – 4,955	3,073 – 7,433
	Biomass Average	6,303	2,900	3,379	3,081	1,993	4,578
	Biomass Rank	1	2	1	1	1	1
	Phenology	5	4	5	6	5	2

[a]Phenology: 1 = vegetative; 2 = jointing; 3 = first emergence of inflorescence; 4 = first anthesis, 10 culms or more; 5 = 50% anthesis; 6 = first seed ripe; 7 = 50% seed ripe; 8 = seed mature; 9 = complete dormancy.

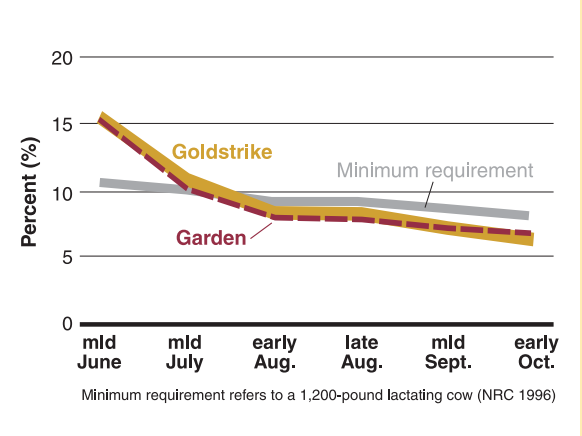
Sand Bluestem



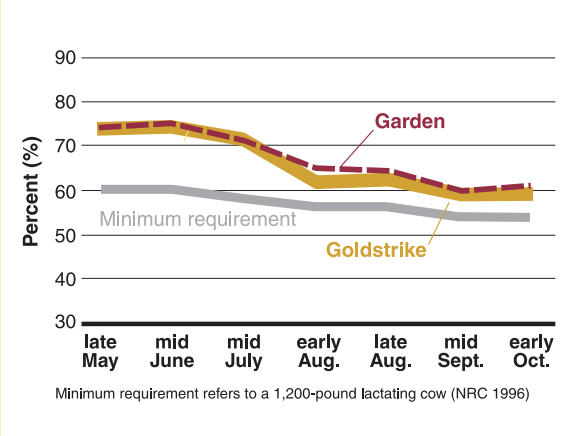
Percent of average peak standing biomass for sand bluestem at Hettinger



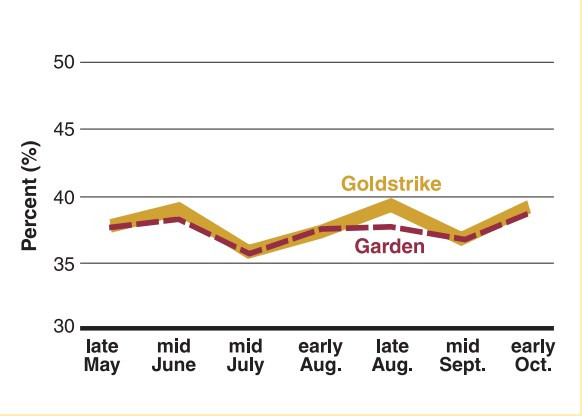
Pounds of acid detergent fiber and netural detergent fiber per acre for each period of sand bluestem



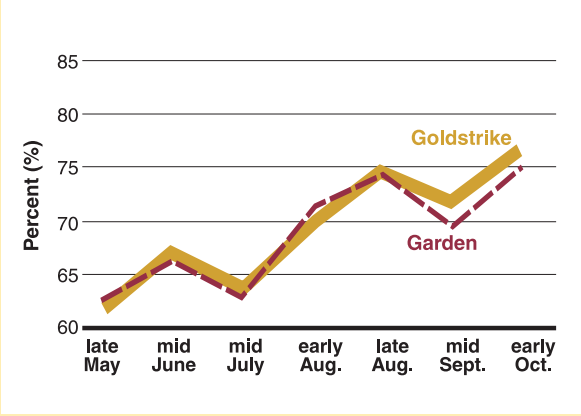
Crude protein content of sand bluestem at Hettinger



In vitro dry-matter digestibility of sand bluestem at Hettinger



Acid detergent fiber of sand bluestem at Hettinger



Neutral detergent fiber of sand bluestem at Hettinger

Grazing Value

Big bluestem typically is preferred over sand bluestem as a pasture grass. However, in areas of limited precipitation and droughty sites consisting of coarse, sand soils, sand bluestem may be the better option. Sand bluestem will provide good grazing from late June through September and is considered a palatable warm-season grass. With proper grazing management, sand bluestem can withstand substantial grazing, but close grazing can decrease the stand. A stubble height of 6 inches is recommended to assure stand longevity. When comparing growth patterns and nutritional value, livestock grazing from mid-June through early August will optimize forage use and nutrient content. A rotational grazing system can extend immature plant growth through early September, reduce trampling loss, enhance utilization, and increase nutritional quality and palatability.

From a grazing management standpoint, sand bluestem should be established in a native plant mixture. Recommended varieties for livestock grazing in the northern Plains are Goldstrike and Garden. Performance data is limited on Cherry.

Recommended Grazing Season:
late June to early September.

Hay Value

The establishment of sand bluestem would not be recommended for use as hayland in a forage system.

Wildlife Value

Sand bluestem is good to excellent forage for many wildlife species, including white-tailed deer and pronghorn. Upland birds eat the seeds. Because it frequently grows in large clumps and retains an upright vegetative structure throughout the winter, it makes an excellent nesting habitat for many upland birds and small mammals.

Sand bluestem should be seeded in a mixture with other native grasses, forbs and legumes to provide structure of various heights as habitat for grassland nesting birds and other wildlife species. Without proper management, cool-season invasive species (Kentucky bluegrass and smooth bromegrass) will become competitive, reducing habitat quality.

Cover Value	**Forage Value**
Spring: Good	Spring: Good
Summer: Good	Summer: Good
Fall: Good	Fall: Fair
Winter: Good	Winter: Poor

Evaluation nursery at the Bismarck Plant Materials Center.

Blue Grama

Blue grama is a native, short statured (less than 18 inches tall), perennial bunchgrass that often can have a sodlike appearance. It reproduces by seed and basal tillers, beginning growth in mid-May and flowering in late July to mid-August. Blue grama leaves begin to curl as they mature and become straw-colored. Mature seed heads are curved and resemble a human eyebrow.

Blue grama has good drought tolerance and is adapted to a wide variety of ecological sites. It has fair tolerance to sodic soils but is not adapted to saline sites. It is the major component of the short-grass prairie. Within the mixed-grass prairie, blue grama usually constitutes a minor component of the native plant community on the loamy and sandy type ecological sites; a larger component on the drier, sands and shallow sites; and a major component on the claypan and thin claypan ecological sites. Blue grama occurs throughout the Great Plains, ranging from Manitoba to Alberta and the Northwest Territories, south throughout the central and western United States and into Mexico.

Blue grama

Releases	Release Type	Date Released	Origin	Statement of Use
Butte Ecovar	Selected	2003	Manitoba and eastern Saskatchewan, Canada	Native collection of blue grama with characteristics typical for the species found in that area. Tests conducted in Manitoba show Butte to have a more dense basal leaf area and earlier and longer green period than southern releases. Recommended in plant hardiness zone 3.
Birdseye	Informal	2000	Wyoming	Recommended in plant hardiness zones 3-4.
Bad River Ecotype	Selected	1996	South Dakota	Improved seedling emergence, vigor and root development compared with South Dakota native harvest. Leafier and taller with higher percent crude protein and digestibility than native harvests from South Dakota. Provides excellent quality forage for summer grazing. Recommended in plant hardiness zones 3-4.
Willis	–	–	Colorado	Not available.

Blue Grama

The NRCS recognizes four release types. These are variety (also commonly referred to as cultivar), tested, selected and source identified. Variety, tested and selected release types have varying degrees of performance data collected for the release. Source-identified releases do not require performance documentation.

Performance Characteristics

Blue grama releases were compared in the Hettinger, N.D., GPNS, but not in the general plant materials trials (original trial). The two releases compared were Bad River and Willis.

Herbage Production

Cumulative herbage production from the GPNS at Hettinger for Bad River and Willis was 2,714 and 2,640 lb/ac, respectively, in 2000 (Table 9).

Growth Patterns

Bad River and Willis had similar growth patterns in Hettinger. Both varieties achieve only 40 percent to 50 percent of their total growth by mid-July. Peak standing crop occurred in early to mid-August for Bad River and early September for Willis in the GPNS. Both varieties senesce at similar rates, with 60 percent to 70 percent standing biomass remaining in early October.

Nutritional Quality

Nutritional quality (CP, IVDMD) was similar between Bad River and Willis at the Hettinger study area throughout the growing season. Blue grama is considered a nutritional, palatable grass for all classes of livestock throughout the growing season. The CP content dropped below 10 percent by early August and remained above 8 percent through early October. In vitro dry-matter digestibility of blue grama was greater than 55 percent through mid to late September at Hettinger.

Fiber Content

Acid detergent fiber (ADF) increased linearly throughout the growing season, peaking at 43 percent by early October for both varieties. Neutral detergent fiber (NDF) was highest in late May, decreasing through mid-July and increasing with maturation for both varieties. This fiber fraction pattern would indicate much of the fiber in May through mid-July is hemi-cellulose, or a more digestible material.

Bad River ranked sixth and Willis seventh out of the 16 warm-season grass varieties studied in terms of average pounds of ADF and NDF produced per acre during the two-year period. Harvesting maximum levels of ADF and NDF of Bad River occurred in late August, with 1,120 and 2,063 lb/ac of ADF and NDF, respectively. Harvesting maximum levels of ADF and NDF of Willis occurred in mid-September, with 1,096 and 2,006 lb/ac of ADF and NDF, respectively.

Grazing Value

Blue grama will provide excellent grazing starting in late June and continuing throughout the growing season. Although palatability and nutritional quality remain high late into the growing season, its grazing value is limited due to low production potential. On native rangeland, blue grama is classified as an increaser with overgrazing or poor grazing management and, depending on ecological site, should comprise only 5 percent to 30 percent of the plant community. In seed mixtures, blue grama usually comprises a small percentage due to its low productivity potential. Blue grama often is added to seed mixtures to meet the needs of a specific niche or soil type.

Blue grama cures well and maintains sufficient protein levels for a nonlactating, early gestational animal into the winter season. However, energy or total digestible nutrients often become deficient during the winter grazing period, especially under harsh environmental conditions.

Blue grama should be established in mixtures with other native plant species. However, if establishing a low-maintenance lawn, blue grama may be seeded as a single species or with buffalo grass. The Bad River ecotype is the recommended release in the Northern Plains. Performance data is limited on other releases at the time of this publication.

Recommended Grazing Season:
late June to early October.

Hay Value

Blue grama is not recommended for hay production because of its low growth stature.

Wildlife Value

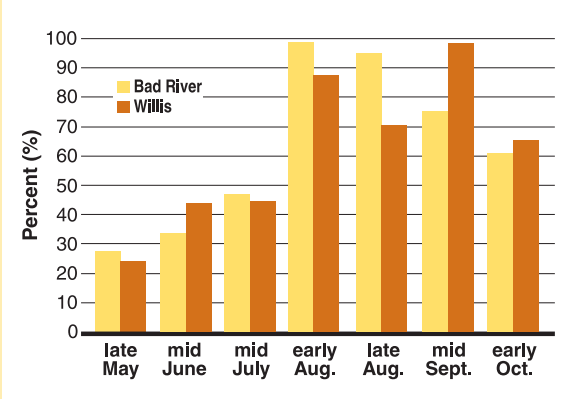
Blue grama is a very valuable species for wildlife, both as a source of seeds for birds and forage for grazers. Wild turkeys and songbirds, such as finches, longspurs and sparrows, utilize the seeds while mammals such as jackrabbits, pronghorn, white-tailed deer, elk and bison graze the vegetative plant parts. Small mammals such as pocket mice will use the seed heads and plant as food. Due to its short stature, blue grama-dominated ecological sites can provide excellent areas for prairie grouse leks.

Blue grama should be seeded in a mixture with other native grasses, forbs and legumes to provide structure of various heights as habitat for grassland nesting birds and other wildlife species. Without proper management, cool-season invasive species (Kentucky bluegrass and smooth bromegrass) will become competitive, reducing habitat quality.

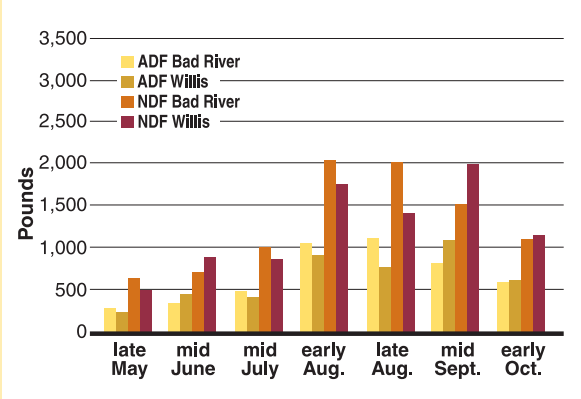
Cover Value
Spring: Poor
Summer: Good
Fall: Fair
Winter: Poor

Forage Value
Spring: Good
Summer: Excellent
Fall: Good
Winter: Good

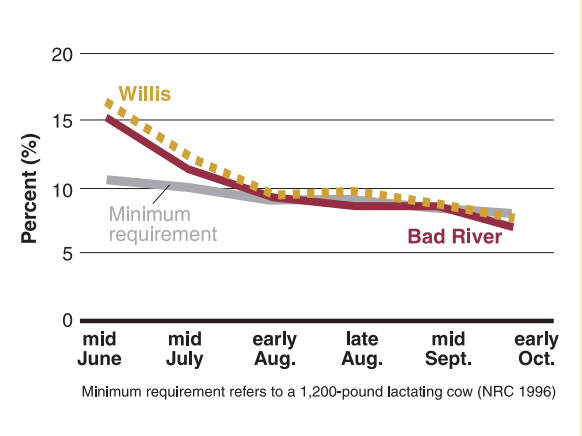
Blue Grama



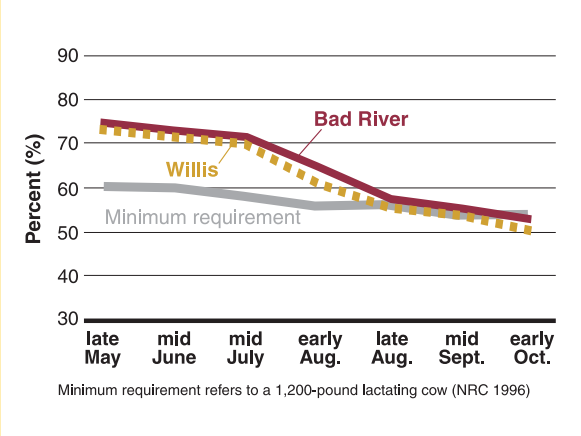
Percent of average peak standing biomass for blue grama at Hettinger



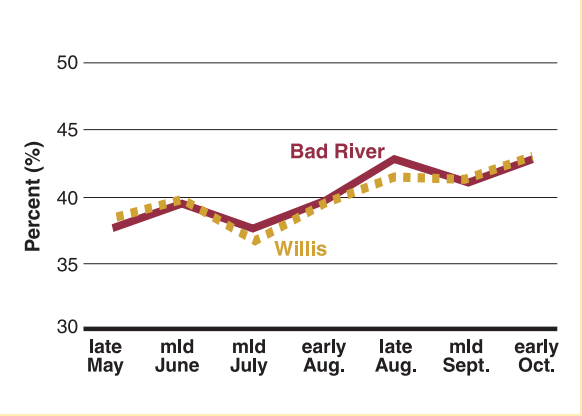
Pounds of acid detergent fiber and netural detergent fiber per acre for each period of blue grama



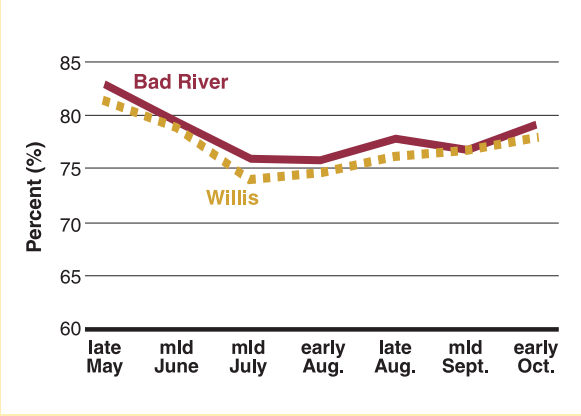
Crude protein content of blue grama at Hettinger



In vitro dry-matter digestibility of blue grama at Hettinger



Acid detergent fiber of blue grama at Hettinger



Neutral detergent fiber of blue grama at Hettinger


BAD RIVER
BLUE GRAMA

Sideoats Grama

Sideoats grama is a native, midstatured (18 to 36 inches tall), perennial, weakly rhizomatous grass with short, scaly underground stems that may give the plant a bunchgrass appearance. It begins growth in mid-May. Flowering occurs in late July to mid-August. The small, oatlike seeds hang down uniformly on one side of the seed stem, hence the name "sideoats." Sideoats grama leaves, normally flat and bluish green with a purplish cast in the early stages of growth, have very distinct stiff hairs along the leaf edges. Late in the summer, the entire plant may take on a reddish cast. Upon curing, the basal leaves curl and dry to a brownish white.

Sideoats grama generally is associated with the drier upland ecological sites, growing in association with little bluestem and prairie sandreed on the thin loamy or shallow-type ecological sites. However, it also may be found growing in association with big bluestem and Indiangrass on the overflow ecological sites. Sideoats grama occurs throughout the United States, except for the northwestern and extreme southeastern states, and most of Mexico.

Sideoats grama

Releases	Release Type	Date Released	Origin	Statement of Use
Southern Iowa Germplasm	Source identified	1995	Iowa	Native harvest from multiple sites in southern Iowa. No intended selection for improvement. Recommended in plant hardiness zone 5.
Central Iowa Germplasm	Source identified	1995	Iowa	Native harvest from multiple sites in central Iowa. No intended selection for improvement. Recommended in plant hardiness zones 4-5.
Northern Iowa Germplasm	Source identified	1995	Iowa	Native harvest from multiple sites in northern Iowa. No intended selection for improvement. Recommended in plant hardiness zone 4.
Killdeer	Informal	1963	North Dakota	Outstanding vigor, leafiness, fair seed production, freedom from disease, good drought and cold tolerance. Recommended in plant hardiness zone 3.
Pierre	Variety	1961	South Dakota	Outstanding vigor, leafiness, freedom from disease, seedling vigor and persistence in a semi-arid environment. Recommended in plant hardiness zones 3-4.
Butte	Variety	1958	Nebraska	Long-lived winter-hardy variety, early maturing with very good seed production. Excellent seedling vigor for establishment. Recommended in plant hardiness zone 4.
Trailway	Variety	1958	Nebraska	Winter-hardy, long-lived, late maturing, comparable in growth type to varieties of more southerly origin. Somewhat indeterminate as to heading and flowering responses, considerable variability in maturity. Recommended in plant hardiness zone 5.

Sideoats Grama

The NRCS recognizes four release types. These are variety (also commonly referred to as cultivar), tested, selected and source-identified. Variety, tested and selected release types have varying degrees of performance data collected for the release. Source-identified releases do not require performance documentation.

Performance Characteristics

Sideoats grama releases were studied for stand rating and density index ratings (Table 16). The releases compared were Killdeer, Pierre, Trailway, and Butte. Stand ratings were fairly similar among sites, although Killdeer and Pierre generally had better ratings at Upham, N.D., Fergus Falls, Minn., and Onida and Lake Andes, S.D. Stand density index ratings generally were good for Killdeer, Pierre and Butte at all locations. Trailway had the lowest stand index rating at each of the six sites.

Sideoats grama was earlier maturing than the other seven species. Mature seed was produced by Killdeer and Pierre in early August at Upham. Killdeer and Pierre were similar in phenology ratings and were earlier maturing than Trailway and Butte (Table 17). Trailway and Butte had mature seed in early September at most sites.

Herbage Production

Location effects (P<0.1) occurred for the six sites in the original study. When creating an average biomass ranking across the six sites (1-4, with the lower number better), Trailway was the most productive variety with a rating of 1.6. Rankings from second through fourth were Butte (2.0), Pierre (3.0) and Killdeer (3.3). Earlier-maturing, northern-origin varieties are less productive than later-maturing, southern-origin varieties (See Table 17 for biomass range, average and ranking for each variety and study area).

Cumulative herbage production from the GPNS for Butte was 376 and 252 lb/ac in 1999 and 2000, respectively, at Fort Pierre and 3,921 lb/ac at Hettinger in 2000 (Table 9). The Pierre variety produced 773 and 412 lb/ac in 1999 and 2000, respectively, at Fort Pierre and 3,362 lb/ac at Hettinger in 2000 (Table 9). Mean herbage production was similar between Butte and Pierre (1,516 vs. 1,515) in the GPNS.

Table 16. Sideoats grama stand rating (1-9)[a] and density index (0-40)[b] at Upham, N.D.; Fergus Falls and Rochester, Minn.; Onida, Fort Pierre and Lake Andes, S.D.

Varieties	Category	Upham	Fergus Falls	Rochester	Onida	Fort Pierre	Lake Andes
Killdeer	Stand Rating	1.0	2.7	3.1	2.3	3.3	1.4
	Density Index	25	28	21	16	24	38
Pierre	Stand Rating	1.0	2.8	2.6	2.5	2.5	1.3
	Density Index	23	26	23	23	29	26
Trailway	Stand Rating	2.1	4.4	3.4	3.0	3.1	2.7
	Density Index	14	12	13	14	23	17
Butte	Stand Rating	1.3	3.4	2.5	3.0	3.5	2.3
	Density Index	24	24	20	15	25	26

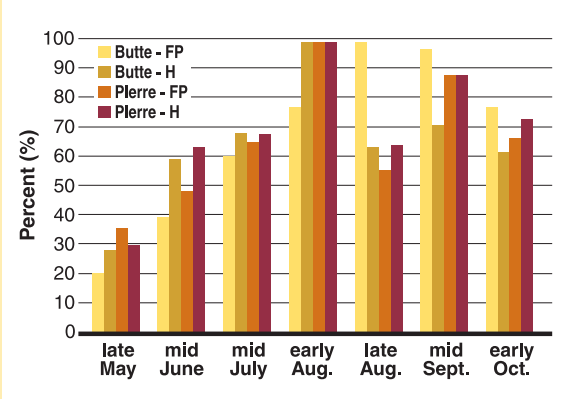
[a]Stand rating: 1 = highest, 9 = lowest.
[b]Density index: estimate of plant density, 40 = highest.

Table 17. Sideoats grama biomass (lb/ac) range and average, mean biomass rank and phenology (1-9)[a] in early September (early August for Upham) at Upham, N.D.; Fergus Falls and Rochester, Minn.; Onida, Fort Pierre and Lake Andes, S.D.

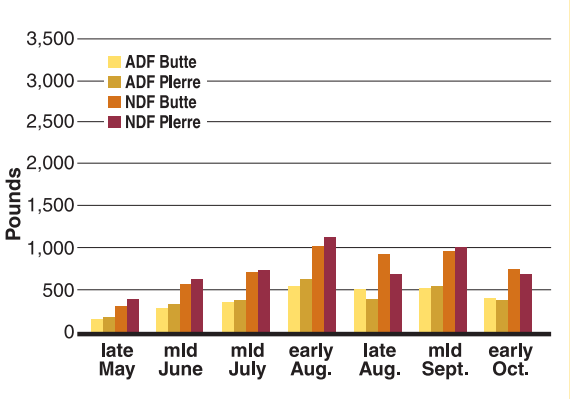
Varieties	Performance	Upham	Fergus Falls	Rochester	Onida	Fort Pierre	Lake Andes
Killdeer	Biomass Range	2,150 – 5,353	317 – 1,372	194 – 910	333 – 2,685	95 – 1,126	677 – 3,559
	Biomass Average	3,826	827	390	1,368	661	2,382
	Biomass Rank	1	4	4	3	4	4
	Phenology	8	8	6	8	8	9
Butte	Biomass Range	1,988 – 5,427	512 – 1,782	366 – 1,554	482 – 3,948	213 – 2,153	1,255 – 3,927
	Biomass Average	3,719	979	676	1,946	1,353	2,748
	Biomass Rank	2	3	2	1	2	2
	Phenology	7	7	6	8	8	9
Pierre	Biomass Range	1,582 – 4,432	436 – 1,789	194 – 1,065	340 – 2,734	303 – 1,496	1,092 – 3,572
	Biomass Average	3,468	1,036	539	1,043	1,049	2,388
	Biomass Rank	3	2	3	4	3	3
	Phenology	8	8	7	8	8	9
Trailway	Biomass Range	2,542 – 3,881	1,445 – 2,683	547 – 2,218	515 – 3,913	460 – 3,292	2,543-5,868
	Biomass Average	3,135	2,068	1,037	1,723	1,472	3,180
	Biomass Rank	4	1	1	2	1	1
	Phenology	6	5	6	8	8	8

[a]Phenology: 1 = vegetative; 2 = jointing; 3 = first emergence of inflorescence; 4 = first anthesis, 10 culms or more; 5 = 50% anthesis; 6 = first seed ripe; 7 = 50% seed ripe; 8 = seed mature; 9 = complete dormancy.

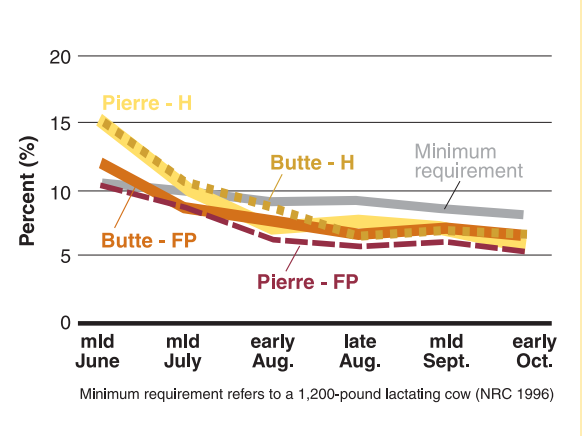
Sideoats Grama



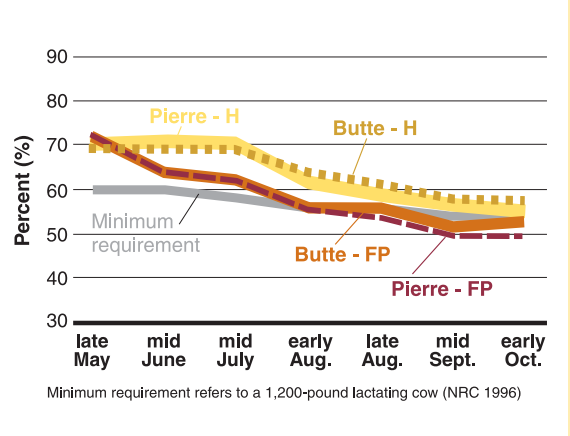
Percent of average peak standing biomass for sideoats grama at Fort Pierre (FP) Hettinger (H)



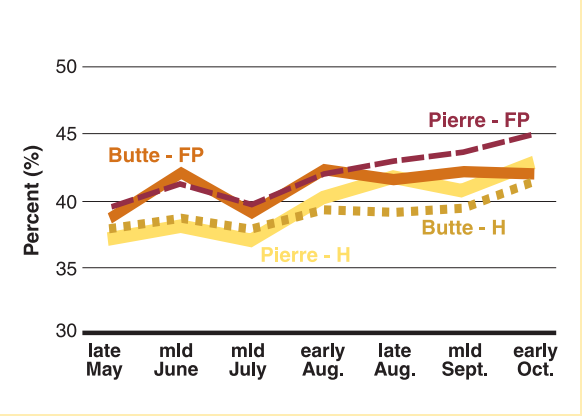
Pounds of acid detergent fiber and netural detergent fiber per acre for each period of sideoats grama



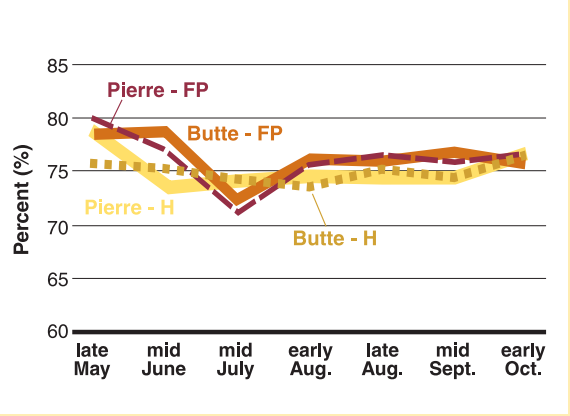
Crude protein content of sideoats grama at Fort Pierre (FP) Hettinger (H)



In vitro dry-matter digestibility of sideoats grama at Fort Pierre (FP) Hettinger (H)



Acid detergent fiber of sideoats grama at Fort Pierre (FP) Hettinger (H)



Neutral detergent fiber of sideoats grama at Fort Pierre (FP) Hettinger (H)

Growth Patterns

The growth pattern was similar between Butte and Pierre at both study locations. Peak standing crop occurred in early to late August for both varieties in the GPNS. On average, senesces was similar between Butte and Pierre, with 60 percent to 75 percent standing biomass remaining in early October.

Nutritional Quality

Sideoats grama is considered a palatable grass for all classes of livestock throughout the growing season; however, it can become deficient of crude protein (CP) and in vitro dry-matter digestibility (IVDMD) with maturation. Nutritional quality (CP, IVDMD) was similar between Butte and Pierre at both study locations (Hettinger and Fort Pierre) in the GPNS. Location was more critical for nutritional status then variety, especially as related to IVDMD. The CP content dropped below 10 percent by early to mid-July, depending on location, and was at 5 percent to 6 percent by early October. Although IVDMD of sideoats grama was significantly greater at Hettinger than Fort Pierre through early August, both sites remainded greater than 55 percent through late August.

Fiber Content

Acid detergent fiber (ADF) increased linearly throughout the growing season, peaking at 42 percent to 45 percent by early October for both varieties. Neutral detergent fiber (NDF) was highest in late May, decreasing through mid-July and increasing with maturation for both varieties. This fiber fraction pattern was similar to blue grama and would indicate much of the fiber in May through mid-July is hemi-cellulose, or a more digestible material.

Pierre ranked 14th and Butte 15th out of the 16 warm-season grass varieties studied in terms of average pounds of ADF and NDF produced per acre during the two-year period. Harvesting maximum levels of ADF and NDF of Pierre occurred from early August through mid-September, with 629 and 1,136 lb/ac of ADF and NDF, respectively. Harvesting maximum levels of ADF and NDF of Butte occurred from early August through mid-September, with 560 and 1,020 lb/ac of ADF and NDF, respectively.

Grazing Value

Sideoats grama will provide excellent grazing starting in late June and continuing throughout the growing season. Although palatability and nutritional quality remain high late into the growing season, its grazing value is limited due to moderate production potential. With proper grazing management, sideoats grama can withstand substantial grazing, but close grazing will decrease the stand. A stubble height of 2 inches is recommended to assure stand longevity. A rotational grazing system can extend immature plant growth through early September, reduce trampling loss, enhance utilization, and increase nutritional quality and palatability.

Sideoats grama should be established in mixtures with other native plant species. Recommended varieties/releases for livestock grazing in North and South Dakota and Minnesota are Killdeer and Pierre. Butte is recommended for South Dakota and Nebraska. Trailway is recommended for southern Nebraska and Kansas. Depending on the origin of the Iowa germplasm releases, they are recommended for southern Minnesota, eastern South Dakota, Iowa, eastern Nebraska and eastern Kansas. Refer to the Release Table for specific hardiness zone.

Recommended Grazing Season:
late June to early September.

Hay Value

Sideoats grama is not recommended for hay production because of its moderate growth stature.

Wildlife Value

Sideoats grama provides good forage for many grazer and browser wildlife species. It is utilized by antelope, mule deer and, to some extent, white-tailed deer and small rodents. The seeds are utilized by some songbirds and upland birds.

Sideoats grama should be seeded in a mixture with other native grasses, forbs and legumes to provide structure of various heights as habitat for grassland nesting birds and other wildlife species. Without proper management, cool-season invasive species (Kentucky bluegrass and smooth bromegrass) will become competitive, reducing habitat quality.

Cover Value
Spring: Fair
Summer: Good
Fall: Fair
Winter: Poor

Forage Value
Spring: Good
Summer: Excellent
Fall: Good
Winter: Fair

Comparing sideoats grama varieties at the Upham site.

Indiangrass

Indiangrass is a native, tall statured (36 to 60 inches tall), perennial, deep-rooted bunchgrass. It reproduces from seed and short, scaly rhizomes. Indiangrass begins growth in mid-May. Flowering occurs in late July to mid-August. The rather dense, golden, plumelike seed heads are very striking. Leaves are lighter green than those of big bluestem and are rather stiff and straight, arising from the stems at acute angles. Even as a young plant, Indiangrass can be recognized easily by the "rifle-sight" ligule at the point where the leaf attaches to the stem.

Historically, Indiangrass was a co-dominate species with big bluestem across the tallgrass prairie and still can be found on the better managed tallgrass prairie remnants. Within the mixed-grass prairie, Indiangrass generally grows in association with big bluestem on overflow and subirrigated ecological sites. It ranges from Quebec and Maine to Manitoba and North Dakota south to Florida, Arizona and New Mexico.

Indiangrass

Releases	Release Type	Date Released	Origin	Statement of Use
Scout	Variety	2008	Nebraska	Higher forage yields and improved animal gains when used by beef cattle in well managed grazing systems. The base population was Nebraska 54. Recommended in plant hardiness zone 5.
Chief	Variety	2008	Nebraska	Higher forage yields than Holt which is one of the parent strains. Recommended in plant hardiness zone 4 and upper plant hardiness zone 5.
Southlow Michigan Germplasm	Source identified	2001	Michigan	Native harvest from the southern half of Michigan's Lower Peninsula. No intended selection. Material does not differ from naturally occurring Indiangrass found in this area. Recommended in plant hardiness zones 4-5.
Southern Iowa Germplasm	Source identified	1998	Iowa	Native harvest from multiple sites in southern Iowa. No intended selection for improvement. Recommended in plant hardiness zone 5.
Northern Iowa Germplasm	Source identified	1997	Iowa	Native harvest from multiple sites in northern Iowa. No intended selection for improvement. Recommended in plant hardiness zone 4.
Central Iowa Germplasm	Source identified	1996	Iowa	Native harvest from multiple sites in central Iowa. No intended selection for improvement. Recommended in plant hardiness zones 4-5.
Tomahawk	Variety	1988	North Dakota, South Dakota	Earlier maturity and superior winter hardiness and persistence. At northern latitudes, forage production is comparable to Holt and exceeds Oto and Rumsey. Matures 33 days earlier than Holt, 71 days earlier than Oto and 82 days earlier than Osage and Rumsey. Recommended in plant hardiness zones 3-4.
Rumsey	Variety	1983	Illinois	Selected for increased seedling growth rate, superior forage production and increased resistance to lodging. Later maturing and should maintain its forage quality later into the growing season. Not winter hardy in tests in North Dakota, South Dakota and Minnesota. Recommended in plant hardiness zone 5.
Holt	Variety	1960	Nebraska	Moderately early maturing. Superior in leafiness and yield to early maturing strains from northern and western sandhill region of Nebraska. Finer leaves and stems than later maturing southern varieties. Recommended in plant hardiness zone 4.
Nebraska 54	Variety	1957	Nebraska	Tall, leafy, moderately late maturing. Can produce high seed yields. Good seedling vigor. Recommended in plant hardiness zones 4-5.

Indiangrass

The NRCS recognizes four release types. These are variety (also commonly referred to as cultivar), tested, selected and source identified. Variety, tested and selected release types have varying degrees of performance data collected for the release. Source-identified releases do not require performance documentation.

Performance Characteristics

Indiangrass releases were studied for stand establishment and density index ratings (Table 18). The releases compared were Tomahawk, Holt, Oto, Osage, and Rumsey. Stand establishment ratings were good for all Indiangrass releases except for Rumsey, which sustained some degree of winter injury at each of the six sites.

The different sites were fairly similar in density index ratings for all the releases, except those with winter injury. Rumsey had low values that ranged from 2 to 13 because of winter injury. Osage (8) and Oto (10) also sustained winter injury at the Upham, N.D., site.

Tomahawk was the most northern-origin release and had the earliest phenology at all six sites (Table 19). Tomahawk averaged 25 to 30 days earlier than Holt, the next earliest maturing release at all sites. The differences noted in phenology were similar at all six sites. Oto, Osage and Rumsey were much later maturing than Tomahawk and generally still were in the jointing stage when Tomahawk had reached mature seed and Holt was at the 50 percent anthesis or first seed ripe stage.

Herbage Production

Year and variety effects ($P<0.1$) occurred at all six sites during the six-year period in the original study. When creating an average biomass ranking across the six sites (1-5, with the lower number better), Holt and Oto were the most productive varieties with a rating of 2.2 to 2.3. Rankings from third through fifth were Osage (2.5), Tomahawk (3.5) and Rumsey (4.5). Earlier maturing, northern-origin varieties are less productive than later-maturing, southern-origin varieties (see Table 19 for biomass range, average and ranking for each variety and study area).

Cumulative herbage production from the GPNS for Holt was 1,908 and 2,261 lb/ac in 1999 and 2000, respectively, at Fort Pierre (Table 9). Tomahawk cumulative herbage production was 2,059 and 1,729 lb/ac in 1999 and 2000, respectively, at Fort Pierre. No difference ($P>0.1$) was found between varieties in 1999 and 2000, and mean herbage production for Holt and Tomahawk was 2,082 and 1,894 lb/ac, respectively (Table 9).

Growth Patterns

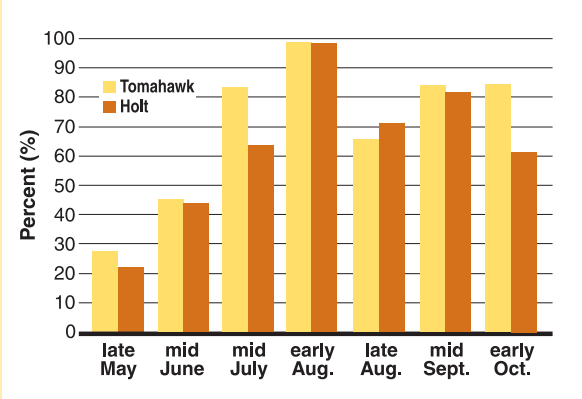
Tomahawk had slightly faster growth than Holt from late June through July; however, both varieties reached peaked herbage production in early August in the GPNS. Both varieties showed substantial regrowth in September; however, regrowth is dependent on late summer rainfall.

Table 18. Indiangrass stand rating (1-9)[a] and density index (0-40)[b] at Upham, N.D.; Fergus Falls and Rochester, Minn.; Onida, Fort Pierre and Lake Andes, S.D.

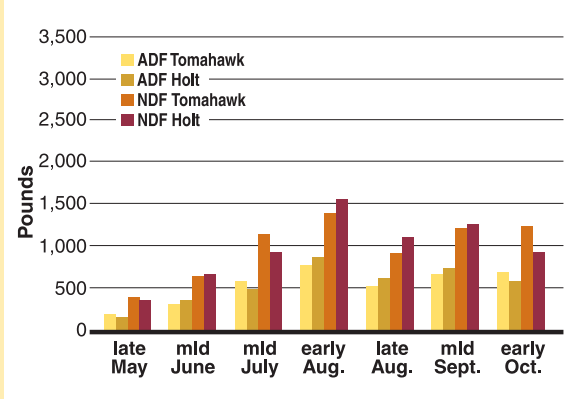
Varieties	Category	Upham	Fergus Falls	Rochester	Onida	Fort Pierre	Lake Andes
Tomahawk	Stand Rating	1.2	3.1	2.9	4.1	5.8	2.5
	Density Index	18	23	7	20	17	16
Holt	Stand Rating	1.4	3.6	3.3	2.5	4.5	2.8
	Density Index	19	17	13	27	25	15
Oto	Stand Rating	4	3.3	4.2	2.7	3.5	1.7
	Density Index	10	21	15	23	31	20
Osage	Stand Rating	3	3.1	3.8	2.9	4.3	1.0
	Density Index	8	16	11	19	24	20
Rumsey	Stand Rating	6.7	5.6	4.4	5.8	6.4	4.9
	Density Index	8	6	4	9	13	2

[a]Stand rating: 1 highest, 9 lowest.
[b]Density index: estimate of plant density, 40 = highest.

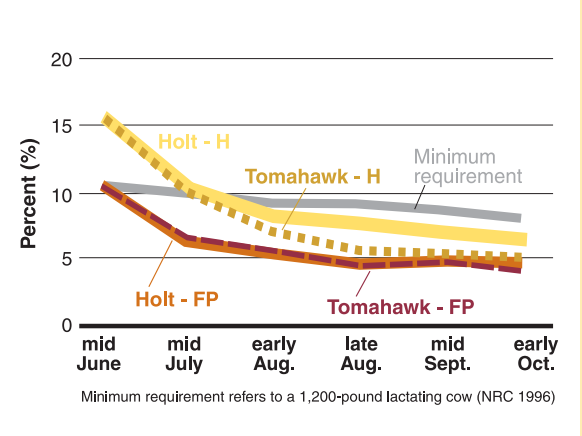
Indiangrass



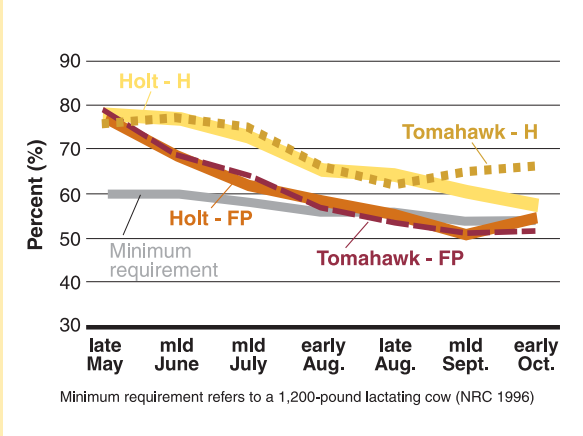
Percent of average peak standing biomass for indiangrass at Fort Pierre



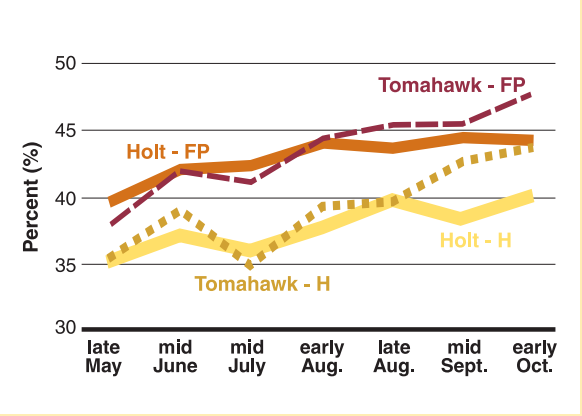
Pounds of acid detergent fiber and netural detergent fiber per acre for each period of indiangrass



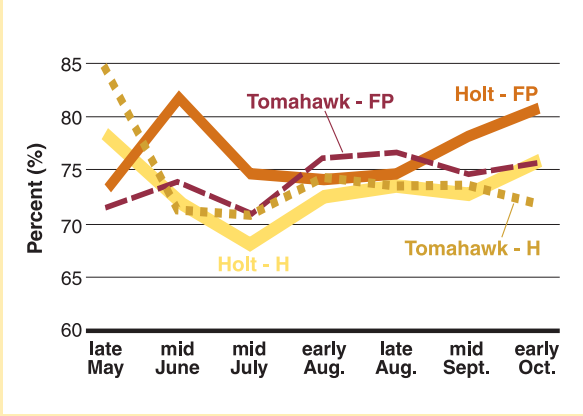
Crude protein content of indiangrass at Fort Pierre



In vitro dry-matter digestibility of indiangrass at Fort Pierre



Acid detergent fiber of indiangrass at Fort Pierre



Neutral detergent fiber of indiangrass at Fort Pierre

Nutritional Quality

Location was more critical in crude protein (CP) and in vitro dry-matter digestibility (IVDMD) than variety in the GPNS. Nutritional quality (CP, IVDMD) was similar between Tomahawk and Holt at both study locations (Hettinger and Fort Pierre); however, Fort Pierre had CP levels 3 percent to 5 percent lower than Hettinger throughout early August, becoming similar by early October. The IVDMD also was similar between varieties, with initial quality similar between Fort Pierre and Hettinger; however, it was 5 percent to 10 percent lower by early October.

Indiangrass is nutritional and palatable for all classes of livestock from June through late August/mid-September. The CP content drops below 10 percent by mid-July to early August, depending on location. Crude protein content was below 5 percent by early October at Fort Pierre and Hettinger. In vitro dry-matter digestibility of Indiangrass was below 55 percent by mid-September at Fort Pierre and early October in Hettinger.

Fiber Content

Fiber content of Indiangrass was lowest at the immature growth stage (early May), increasing through maturation and peaking at the end of the growing season. Acid detergent (ADF) and neutral detergent fiber (NDF) increased linearly throughout the growing season, with ADF peaking at 43 percent and 46 percent by early October for Holt and Tomahawk, respectively. However, NDF was greater in Holt in early October at 77 percent, compared with Tomahawk at 73 percent. Higher NDF levels indicate a greater level of cellulose, thus an overall coarser plant.

Holt ranked 11th and Tomahawk 13th out of the 16 warm-season grass varieties studied in terms of average pounds of ADF and NDF produced per acre during the two-year period. Harvesting maximum levels of ADF and NDF of Holt occurred in early August, with 874 and 1,562 lb/ac of ADF and NDF, respectively. Harvesting maximum levels of ADF and NDF of Tomahawk occurred in early August, with 776 and 1,392 lb/ac of ADF and NDF, respectively.

Table 19. Indiangrass biomass (lb/ac) range and average, mean biomass rank and phenology (1-9)[a] in early September (early August for Upham) at Upham, N.D.; Fergus Falls and Rochester, Minn.; Onida, Fort Pierre and Lake Andes, S.D.

Varieties	Performance	Upham	Fergus Falls	Rochester	Onida	Fort Pierre	Lake Andes
Tomahawk	Biomass Range	2,419 – 5,729	973 – 4,566	1,184 – 2,814	365 – 5,127	81 – 1,494	2,413 – 4,824
	BiomassAverage	4,156	2,908	2,133	2,041	981	3,508
	Biomass Rank	1	3	4	4	4	5
	Phenology	6	6	6	8	7	8
Holt	Biomass Range	2,668 – 4,937	1,743 – 5,791	1,266 – 5,451	1,014 – 6,183	242 – 2,991	3,412 – 9,860
	Biomass Average	3,869	4,127	2,501	2,800	1,282	5,250
	Biomass Rank	2	1	3	1	3	4
	Phenology	4	4	5	6	5	5
Oto	Biomass Range	1,695 – 4,980	818 – 4,623	769 – 9,136	457 – 7,439	214 – 5,142	5,063 – 10,223
	Biomass Average	3,094	2,318	3,034	2,504	2,091	6,938
	Biomass Rank	3	5	1	2	1	1
	Phenology	1	1	2	3	2	3
Osage	Biomass Range	716 – 3,725	1,494 – 5,262	1,059 – 8,752	483 – 6,071	256 – 4,662	4,857 – 9,720
	Biomass Average	2,656	3,158	2,898	2,402	1,634	6,614
	Biomass Rank	4	2	2	3	2	2
	Phenology	1	1	3	2	2	3
Rumsey	Biomass Range	538 – 3,852	1,712 – 3,844	1,151 – 3,461	197 – 1,887	376 – 729	3,612 – 9,077
	Biomass Average	1,743	2,588	2,082	861	452	5,552
	Biomass Rank	5	4	5	5	5	3
	Phenology	1	1	4	2	2	3

[a]Phenology: 1 = vegetative; 2 = jointing; 3 = first emergence of inflorescence; 4 = first anthesis, 10 culms or more; 5 = 50% anthesis; 6 = first seed ripe; 7 = 50% seed ripe; 8 = seed mature; 9 = complete dormancy.

Grazing Value

Indiangrass will provide good grazing from June through September and is considered a highly palatable warm-season grass. A stubble height of 6 inches is recommended to assure stand longevity. Tomahawk is the earliest maturing variety, with grazing recommended from late June when grasses reach a height of 8 to 14 inches through mid-September. Holt matures about 15 to 30 days later than Tomahawk and is recommended for grazing from early to mid-July through early September. When comparing growth patterns and nutritional value, livestock grazing from late June through early September will optimize forage use and nutrient content. A rotational grazing system can extend immature plant growth through early September, reduce trampling loss, enhance utilization, and increase nutritional quality and palatability.

From a grazing management standpoint, Indiangrass could be established as a pure stand for pasture development or incorporated into a native plant mixture. The recommended variety for livestock grazing in North and South Dakota and northern Minnesota is Tomahawk. Holt is recommended for Nebraska, Iowa, South Dakota and southern Minnesota.

Recommended Grazing Season:
late June to early September (depending on variety).

Hay Value

Indiangrass can make good hay; however, it typically is not recommended in pure stands for hay land in the Northern Plains. Hay land development with Indiangrass may be applicable when mixed with big bluestem and switchgrass. It is palatable when immature; however, it becomes less desirable once maturation occurs and fiber increases. Proper harvest technique for optimum stand maintenance would be to leave a stubble height of 6 inches and achieve adequate regrowth (about 10 inches) prior to the first killing frost.

Indiangrass should be cut by the early boot to boot growth stage to maintain good CP (9 percent to 10 percent) and IVDMD (> 55 percent) for winter feed and at flowering to maintain a CP and IVDMD level for nonlactating animals.

The recommended variety for hay production in North and South Dakota and northern Minnesota is Tomahawk. Holt is recommended for Nebraska, Iowa, South Dakota and southern Minnesota.

Recommended Haying Time:
late July to early August for a nonlactating ration that achieves a maintenance quality with optimum forage production and early to mid-July for lactating ration, optimum quality and lower production (variety dependant).

Wildlife Value

Indiangrass provides limited feed value for songbirds, white-tailed deer and antelope. Seeds are used sparingly by upland game and songbirds. Meadow and pocket mice make some use of the seed. Indiangrass provides good wildlife nesting cover with limited winter (thermal) cover since it does not hold up under snow as well as switchgrass or big bluestem.

Indiangrass should be seeded in a mixture with other native grasses, forbs and legumes to provide structure of various heights as habitat for grassland nesting birds and other wildlife species. Without proper management, cool-season invasive species (Kentucky bluegrass and smooth bromegrass) will become competitive, reducing habitat quality.

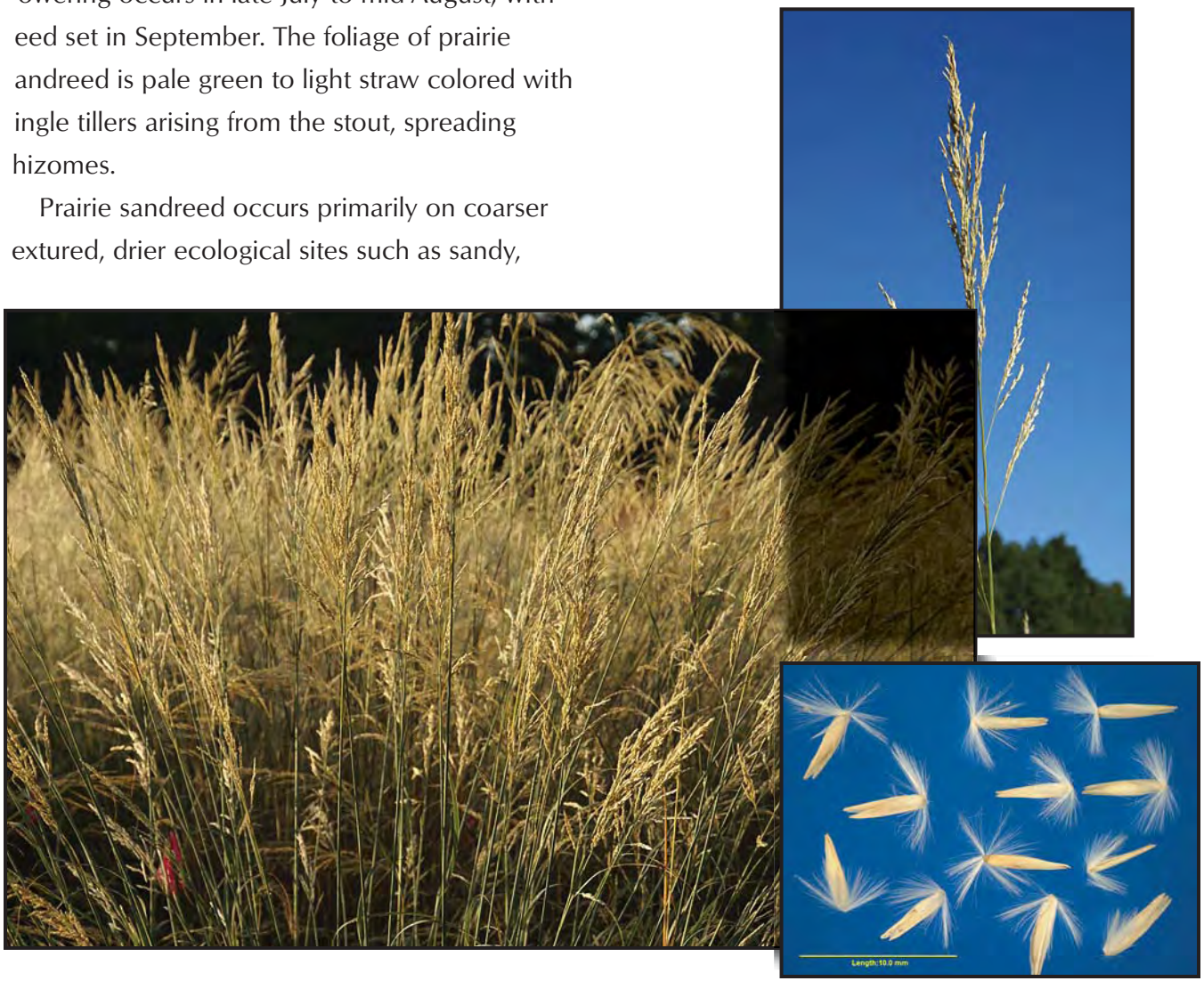
Cover Value	**Forage Value**
Spring: Good	Spring: Good
Summer: Good	Summer: Good
Fall: Good	Fall: Fair
Winter: Good	Winter: Poor

Evaluation nursery.

Prairie Sandreed

Prairie sandreed is a native, tall statured (36 to 60 inches tall), rhizomatous perennial grass ith a coarse, fibrous root system. Reproduction s by seed or vegetatively from scaly rhizomes. hizomes are extensive, horizontally creeping, ale whitish, stout, scaly and shiny, with the very harp pointed tips, much like a rooster's spur. rairie sandreed begins growth in mid-May and owering occurs in late July to mid-August, with eed set in September. The foliage of prairie andreed is pale green to light straw colored with ingle tillers arising from the stout, spreading hizomes.

Prairie sandreed occurs primarily on coarser extured, drier ecological sites such as sandy, sands, choppy sands, thin sands, shallow sands and limy sands. The pale green to light straw color makes the colonies of prairie sandreed very noticeable on these sites. Prairie sandreed is found throughout the northern Great Plains and occurs from Manitoba to Alberta south to Idaho, Kansas, Colorado and Indiana.



Prairie sandreed

Releases	Release Type	Date Released	Origin	Statement of Use
Badger Ecovar	Selected	Pending	prairie Canada	Increased rust resistance. Recommended in plant hardiness zone 3.
Koch Germplasm	Selected	2007	Michigan	Selected for upright growth habit, improved seed production and vigor. Recommended in plant hardiness zones 4-5.
Bowman (ND-95)	Informal	2000	North Dakota	Leafy northern type with good, vigorous growth. Forage production is comparable to Goshen in the northern US but ND-95 has demonstrated improved performance in parts of Canada. Recommended in plant hardiness zone 3.
Pronghorn	Variety	1988	Nebraska, Kansas, South Dakota	Broad genetic base. Higher degree of rust tolerance than Goshen but similar to Goshen in forage and stand attributes. Recommended for use in revegetating sandy sites in the Nebraska Sandhills and northwestern Kansas. Recommended in plant hardiness zones 4-5.
Goshen	Variety	1976	Wyoming	Leafy with excellent seed production. Late maturing with basal leaves and mildly rhizomatous. Drought tolerant, adapted to sandy sites. Recommended in plant zone hardiness zone 4.

Prairie Sandreed

The NRCS recognizes four release types. These are variety (also commonly referred to as cultivar), tested, selected and source identified. Variety, tested and selected release types have varying degrees of performance data collected for the release. Source-identified releases do not require performance documentation.

Performance Characteristics

Prairie sandreed releases were studied for stand establishment and density index ratings (Table 20). The releases compared were Goshen and Bowman. Stand ratings were similar for both releases at each site, but variation occurred among sites. The plots at Upham, N.D., had the highest stand ratings (1.2 for Goshen and 1.4 for Bowman), and the plots at Fort Pierre, S.D., had the lowest ratings (7.0 for Goshen and 6.6 for Bowman). The Fort Pierre plots were on heavy clay soils and the poor stand ratings may have been related to soil crusting during seedling emergence.

Density index ratings generally were less for prairie sandreed, compared with the other species and ranged from a low of 2 for Goshen at Fort Pierre to a high of 18 for Bowman at Lake Andes, S.D. Comparing the total average density index ratings at all six sites, Bowman (11.2) was slightly higher than Goshen (8.3). Leaf and stem rust was a severe problem on the higher rainfall sites. The prairie sandreed plots at Lake Andes were destroyed by rust the sixth year after seeding and no biomass data was collected. No specific damage caused by winter injury was noted for either entry.

No significant differences occurred in phenology between the two releases (Table 21). Bowman was rated slightly earlier in maturity than Goshen at Lake Andes and Onida, S.D. Average maturity at the six locations was first seed ripe in early September.

Herbage Production

No year and variety effects (P<0.1) occurred at all six sites during the six-year period in the original study. When creating an average biomass ranking across the six sites (1-2, with the lower number better), both Bowman and Goshen ranked the same at 1.5 (see Table 21 for biomass range, average and ranking for each variety and study area).

Cumulative herbage production from the GPNS for Bowman was 2,076 lb/ac at Hettinger in 2000, and 3,208 and 3,809 lb/ac in 1999 and 2000, respectively, at Fort Pierre (Table 9). Cumulative herbage production from the GPNS for Goshen was 1,529 lb/ac at Hettinger in 2000, and 1,613 and 3,083 lb/ac in 1999 and 2000, respectively, at Fort Pierre. Bowman had greater (P<0.1) cumulative herbage production than Goshen at the Fort Pierre study site but not different (P>0.l) at Hettinger.

Growth Patterns

Goshen appears to grow slightly quicker than Bowman through July. On average, both varieties reach peak herbage production in mid-September. Bowman and Goshen have a similar midsummer growth pattern; however, Bowman appears to senesce more rapidly in October.

Nutritional Quality

Location was more critical in crude protein (CP) and in vitro dry-matter digestibility (IVDMD) than variety in the GPNS. Nutritional quality (CP, IVDMD) was similar between Bowman and Goshen at both study locations (Hettinger and Fort Pierre); however, Fort Pierre had CP levels 3 percent to 5 percent lower than Hettinger throughout the growing season. The IVDMD also was similar between varieties, with initial quality similar

Table 20. Prairie sandreed stand rating (1-9)[a] and density index (0-40)[b] at Upham, N.D.; Fergus Falls and Rochester, Minn.; Onida, Fort Pierre and Lake Andes, S.D.

Varieties	Category	Upham	Fergus Falls	Rochester	Onida	Fort Pierre	Lake Andes
Bowman	Stand Rating	1.4	4.5	4.6	2.1	6.6	4.9
	Density Index	12	15	6	15	4	18
Goshen	Stand Rating	1.2	4.6	4.9	2.4	7	6.2
	Density Index	10	12	6	12	2	5

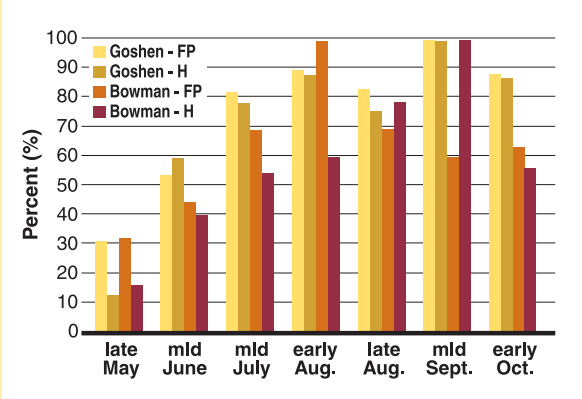
[a]Stand rating: 1 highest, 9 lowest.
[b]Density index: estimate of plant density, 40 = highest.

Table 21. Prairie sandreed biomass (lb/ac) range and average, mean biomass rank and phenology (1-9)[a] in early September (early August for Upham) at Upham, N.D.; Fergus Falls and Rochester, Minn.; Onida, Fort Pierre and Lake Andes, S.D.

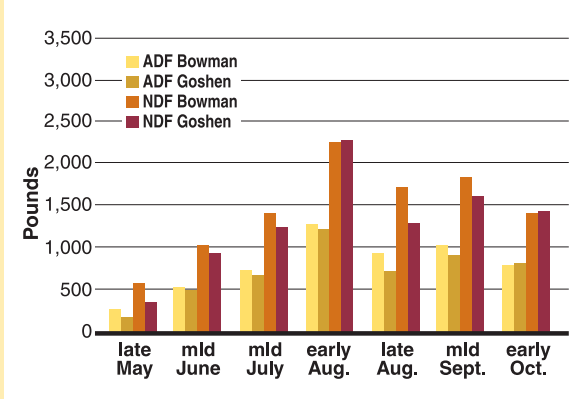
Varieties	Performance	Upham	Fergus Falls	Rochester	Onida	Fort Pierre	Lake Andes
Bowman	Biomass Range	4,389 – 8,352	1,203 – 3,786	456 – 1,482	1,181 – 7,791	1,256 – 3,714	179 – 2,000
	Biomass Average	5,359	2,592	787	3,282	2,660	1,080
	Biomass Rank	2	2	1	2	1	1
	Phenology	7	4	6	6	5	7
Goshen	Biomass Range	3,626 – 7,295	1,635 – 3,376	168 – 773	1,529 – 7,578	844 – 3,927	0 – 995
	Biomass Average	5,620	2,642	596	4,060	2,490	535
	Biomass Rank	1	1	2	1	2	2
	Phenology	7	5	6	5	5	5

[a]Phenology: 1 = vegetative; 2 = jointing; 3 = first emergence of inflorescence; 4 = first anthesis, 10 culms or more; 5 = 50% anthesis; 6 = first seed ripe; 7 = 50% seed ripe; 8 = seed mature; 9 = complete dormancy.

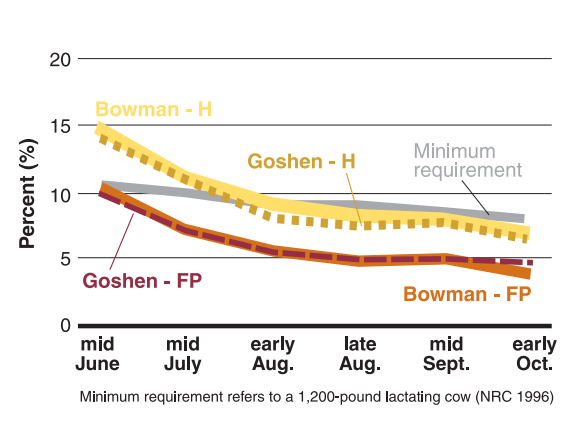
Prairie Sandreed



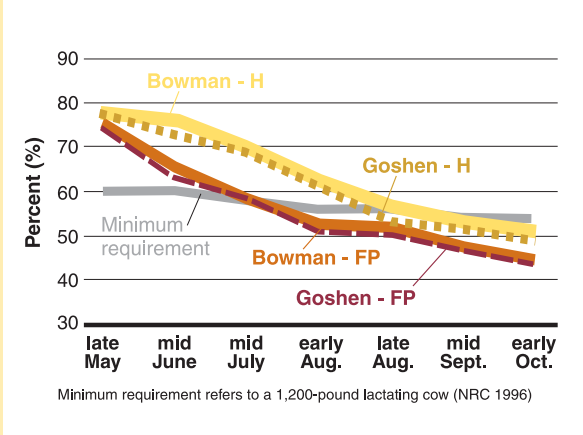
Percent of average peak standing biomass for prairie sandreed at Fort Pierre (FP) and Hettinger (H)



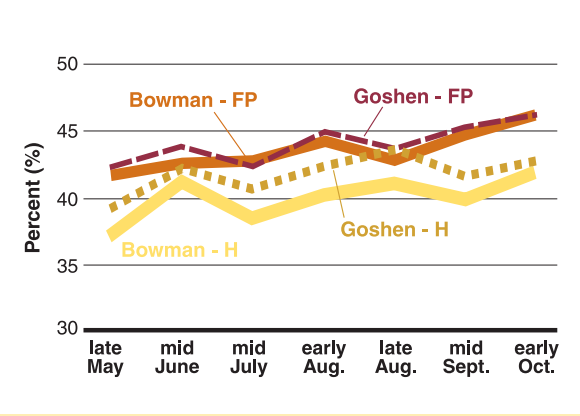
Pounds of acid detergent fiber and netural detergent fiber per acre for each period of prairie sandreed



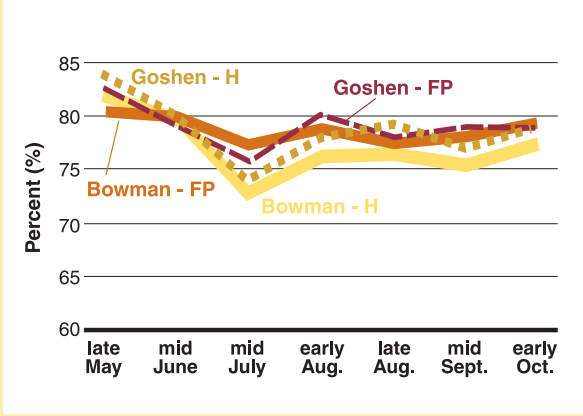
Crude protein content of prairie sandreed at Fort Pierre (FP) and Hettinger (H)



In vitro dry-matter digestibility of prairie sandreed at Fort Pierre (FP) and Hettinger (H)



Acid detergent fiber of prairie sandreed at Fort Pierre (FP) and Hettinger (H)



Neutral detergent fiber of prairie sandreed at Fort Pierre (FP) and Hettinger (H)

between Fort Pierre and Hettinger; however, it was 4 percent to 8 percent lower throughout the remaining growing season.

Fiber Content

Fiber content of sand bluestem was lowest at the immature growth stage (early May to early June), increasing through maturation and peaking at the end of the growing season. Neutral detergent fiber (NDF) did not change much throughout the growing season, while ADF increased linearly, peaking at 43 percent and 46 percent in early October, depending on site.

Bowman ranked ninth for consistency and Goshen 10th out of the 16 warm-season grass varieties studied in terms of average pounds of ADF and NDF produced per acre during the two-year period. Harvesting maximum levels of ADF and NDF of Bowman occurred from early August through mid-September, with 1,043 and 1,867 lb/ac of ADF and NDF, respectively. Harvesting maximum levels of ADF and NDF of Goshen occurred in mid-September, with 913 and 1,649 lb/ac of ADF and NDF, respectively.

Grazing Value

Prairie sandreed has low palatability during the growing season and therefore is not a preferred pasture grass. However, once exposed to a killing frost, lignin is reduced and palatability improves. With proper grazing management, prairie sandreed can withstand grazing pressure, but close grazing will decrease the plant populations. A stubble height of 4 inches is recommended to assure stand longevity. When comparing growth patterns and nutritional value, livestock grazing from mid-June through late August will optimize forage use and nutrient content. A rotational grazing system can extend immature plant growth through early September, reduce trampling loss, enhance utilization, and increase nutritional quality and palatability.

From a grazing management standpoint, prairie sandreed should be incorporated into a native plant mixture. Bowman and Goshen are the recommended varieties for livestock grazing in the western Dakotas and western Nebraska. Koch appears to be more disease resistant and better adapted to Minnesota, Iowa, eastern Nebraska and eastern South Dakota. Pronghorn also appears to be more disease resistant and adapted for Kansas, Nebraska and southern South Dakota. Badger is a new ecovar pending release from Prairie Canada and is expected to be better adapted at northern locations.

Recommended Grazing Season:
mid-June to late August and after early October.

Hay Value

The establishment of prairie sandreed would not be recommended for use as hay land in a forage system.

Wildlife Value

Prairie sandreed provides good to fair forage for grazing wildlife in early spring and summer. The plant's forage value increases in importance in late fall and winter as the plant cures well on the stem and provides upright and accessible forage. Seeds are thought to be used by songbirds and small rodents.

Prairie sandreed should be seeded in a mixture with other native grasses, forbs and legumes to provide structure of various heights as habitat for grassland nesting birds and other wildlife species. Other adapted grass and forb species are somewhat limited because prairie sandreed primarily occurs on coarser textured, drier ecological sites. Without proper management, cool-season invasive species (Kentucky bluegrass and smooth bromegrass) will become competitive, reducing habitat quality.

Cover Value	Forage Value
Spring: Good	Spring: Good
Summer: Good	Summer: Fair
Fall: Good	Fall: Good
Winter: Good	Winter: Good

Evaluation nursery.

Switchgrass

Switchgrass is a native, tall statured (36 to 60 inches tall), sod-forming perennial grass with stout rhizomes. It has a deep, vigorous root system that may grow to a depth of 9 feet. Switchgrass is capable of reproducing from underground stems and seed. Switchgrass begins growth in mid-May and flowers from late June to early August, with seed dispersal occurring in late August to early September. The seeds germinate readily and possess good seedling vigor. Switchgrass can be distinguished from other warm-season grasses by the patch of hair at the point where the leaf attaches to the stem. Although switchgrass is adapted to a wide range of soils, it is better adapted to moist ecological sites, such as overflow and subirrigated. Switchgrass has a fair tolerance to salinity. In seeded situations, it performs well on drier sites, such as loamy or sandy ecological sites. Switchgrass is especially valuable for hay, pasture, erosion control and wildlife habitat. It is considered a desirable biofuel resource to meet emerging energy needs.

Switchgrass

Southlow Michigan Germplasm	Selected	2001	Michigan	A multiorigin germplasm assembled from 11 native stands in the southern half of Michigan's Lower Peninsula. A genetically diverse seed source that has had no purposeful selection. Recommended in plant hardiness zones 4-5.
Dacotah	Variety	1989	North Dakota	A winter-hardy, leafy variety. High plant vigor and seed yields. 27 days earlier in anthesis than Forestburg and 45-50 days earlier than Blackwell, Summer, Cave-in-Rock, Pathfinder and Nebraska 28. Shorter in mature height and has less coarse growth than southern varieties. Appears to have increased drought tolerance for the species. Recommended in plant hardiness zone 3.
Forestburg	Variety	1987	South Dakota	Superior winter hardiness, persistence and seed production. Earlier maturing than most other varieties. Forage production at northern latitudes exceeds that of Dacotah and is equal to or greater than Nebraska 28. Forestburg is similar in performance and adaptation to Sunburst. Average daily gains of yearling steers were slightly higher for Forestburg than Pathfinder in grazing studies at Morris, Minn. Recommended in plant hardiness zones 3-4.
Trailblazer	Variety	1984	Nebraska	Similar to Pathfinder in maturity, appearance and area of adaptation. Higher in vitro dry-matter digestibility than Pathfinder. Recommended in plant hardiness zones 4-5.
Cave-in-Rock	Variety	1974	Illinois	Very good seedling vigor, more resistance to damping off or leaf spot, higher seed yields, resistant to lodging, lowland type of switchgrass. Tolerant to flooding and will withstand droughty soils but is better adapted to moderately wet soils. Recommended in plant hardiness zones 5-6.
Pathfinder	Variety	1967	Nebraska	Winter hardy, vigorous, leafy, late maturing and rust resistant in regions where it is adapted. Good stand establishment and forage production for late spring and summer grazing. Most favorable area for seed production is in eastern third of Nebraska south of Platte River. Recommended in plant hardiness zones 4-5.
Summer	Variety	1963	South Dakota	Tall, upright with abundant, somewhat coarse leaves. Starts growth after June 1 and matures seed in mid-September. Produces high yields of forage and seed. Seed is small in size compared with other varieties of switchgrass. Recommended in plant hardiness zone 4.
Nebraska 28	Variety	1949	Nebraska	Relatively early maturing strain of switchgrass, representative of Nebraska sandhill types. Considerable variation in plant type. Matures seed in mid-August to early September. In areas with longer growing seasons, is susceptible to rust, which is likely to be a serious factor in production. Recommended in plant hardiness zones 4-5.

Blackwell	Variety	1944	Oklahoma	Upland type of switchgrass of medium height with rather large stems. High in leafiness, total forage produced, and resistance to rust and other diseases. Good seedling vigor. Adapted to Kansas, Oklahoma, southern Nebraska and northern Texas in areas of 19.7 inches or more of annual precipitation. Recommended in plant hardiness zone 5.

Switchgrass

The NRCS recognizes four release types. These are variety (also commonly referred to as cultivar), tested, selected and source identified. Variety, tested and selected release types have varying degrees of performance data collected for the release. Source-identified releases do not require performance documentation.

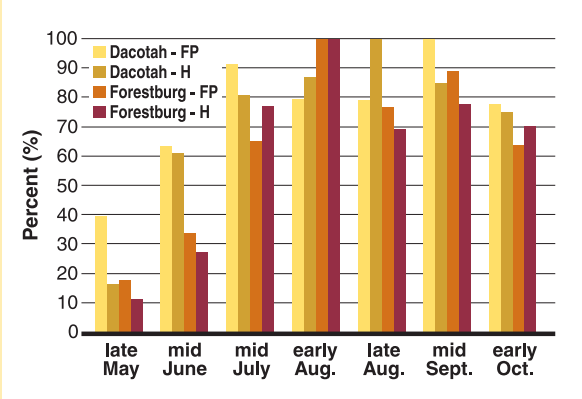
Performance Characteristics

Switchgrass releases were studied for stand establishment and density index ratings in the original study (Table 22). The releases compared were Dacotah, Sunburst, Forestburg, Nebraska 28, Summer, Pathfinder, Cave-in-Rock, and Blackwell. Stand establishment ratings generally were good for all switchgrass entries across all sites. Stand ratings were similar for all releases, but variation did occur among sites. The switchgrass plots at Fort Pierre, S.D., had the lowest rated stands overall. This was the only site with heavy clay soils and the low-rated stands may have been related to soil crusting during seedling emergence of the small seed. The plots at Upham, N.D., and Lake Andes, S.D., had the highest rated stands and also the most productive soils.

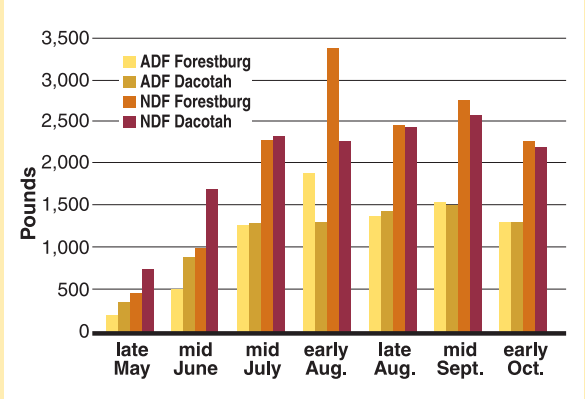
Dacotah and Forestburg were the two northern-most origin releases and generally were noted to have among the highest density index ratings. Stand index density was determined by estimating the number of plants in a 9-inch by 16-inch frame. The density index rating was developed with values ranging from 0 (no stand) to 40 (full stand) to estimate density. Values ranged from 23 to 29 for Dacotah and 23 to 34 for Forestburg. The lower density index ratings generally were associated with the more southern origin releases. Comparing the six sites, Lake Andes, S.D., had the highest range of values (20

Dacotah switchgrass (left) matured about 3 weeks earlier than Sunburst (right) at the Onida site.

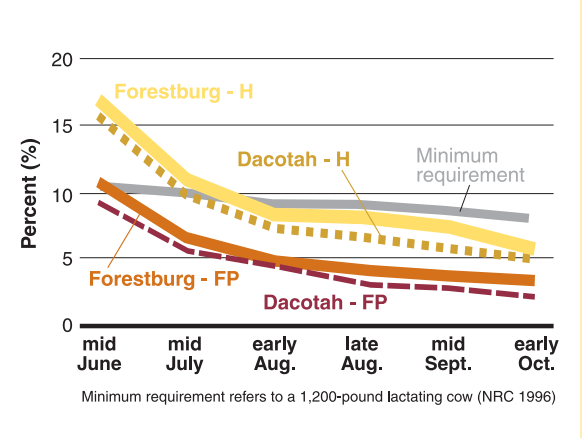
Switchgrass



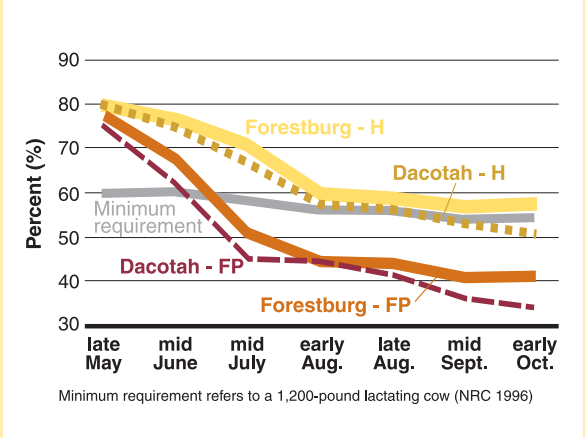
Percent of average peak standing biomass for switchgrass at Fort Pierre (FP) and Hettinger (H)



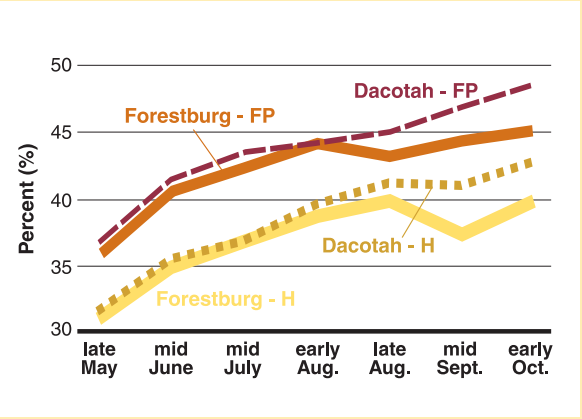
Pounds of acid detergent fiber and netural detergent fiber per acre for each period of switchgrass



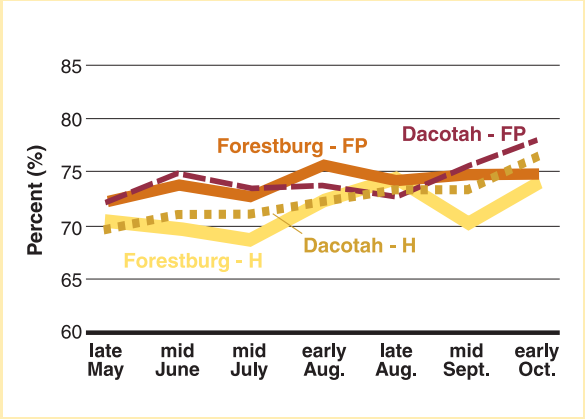
Crude protein content of prairie switchgrass at Fort Pierre (FP) and Hettinger (H)



In vitro dry-matter digestibility of switchgrass at Fort Pierre (FP) and Hettinger (H)



Acid detergent fiber of switchgrass at Fort Pierre (FP) and Hettinger (H)



Neutral detergent fiber of switchgrass at Fort Pierre (FP) and Hettinger (H)

to 34) and Rochester, Minn., had the lowest (12 to 24). No specific damage caused by winter injury was noted for any of the switchgrass entries, including those of southern origin.

The varietal differences noted in phenology were similar at all six sites (Table 23). Dacotah had the earliest maturity. Generally, Forestburg, Nebraska 28 and Sunburst were about 25 to 30 days later than Dacotah. Summer, Pathfinder, Cave-in-Rock and Blackwell matured later and still were vegetative or just jointing when Dacotah had reached mature seed at the Upham and Lake Andes sites.

Herbage Production

Year and variety effects (P<0.1) occurred at all six sites during the six-year period in the original study. When creating an average biomass ranking across the six sites (1-8, with the lower number better), Summer was the most productive variety with a rating of 1.8. Rankings from second through eighth were Sunburst (3.0), Pathfinder (3.2), Blackwell (3.2), Cave-in-Rock (4.8), Nebraska 28 (5.7), Forestburg (6.3) and Dacotah (8.0). Earlier-maturing, northern-origin varieties are less productive than later-maturing, southern-origin varieties (See Table 23 for biomass range, average and ranking for each variety and study area).

Cumulative herbage production for Dacotah was 3,183 and 3,154 lb/ac in 1999 and 2000, respectively, and for Forestburg 2,992 and 5,343 lb/ac in 1999 and 2000, respectively, at Fort Pierre from the GPNS (Table 9). Although no difference (P>0.1) occurred between varieties in 1999, Forestburg was greater (P<0.1) than Dacotah at Fort Pierre in 2000. Cumulative herbage production of Forestburg also was greater (P<0.1) than Dacotah (5,447 vs. 4,127 lb/ac) at Hettinger in 2000 (Table 9).

Growth Patterns

On average, a yearly difference in timing of peak standing crop occurred in the GPNS. Forestburg reached peaked herbage production in early August at both study sites and years. Dacotah reached peak herbage produc-

Table 22. Switchgrass stand rating (1-9)[a] and density index (0-40)[b] at Upham, N.D.; Fergus Falls and Rochester, Minn.; Onida, Fort Pierre and Lake Andes, S.D.

Varieties	Category	Upham	Fergus Falls	Rochester	Onida	Fort Pierre	Lake Andes
Summer	Stand Rating	1	2.5	1.6	1.8	5	1.3
	Density Index	21	22	14	24	14	27
Sunburst	Stand Rating	1	2.6	1.9	2.2	3.5	1.3
	Density Index	18	20	15	28	22	20
Pathfinder	Stand Rating	1.1	2.9	2.5	1.6	4.1	1.6
	Density Index	27	18	24	27	20	33
Trailblazer	Stand Rating	NA	NA	2.3	NA	NA	4.1
	Density Index	NA	NA	12	NA	NA	21
Blackwell	Stand Rating	1	2.9	2.3	1.7	3.7	1.6
	Density Index	20	23	21	25	23	28
Cave-in Rock	Stand Rating	1.3	3.3	2.2	2.5	5.6	1.7
	Density Index	19	18	18	21	12	20
Nebraska 28	Stand Rating	1	3.5	2.2	2.0	2.8	1.6
	Density Index	12	16	17	31	26	28
Forestburg	Stand Rating	1.7	3.3	3.0	1.8	3.3	1.5
	Density Index	27	27	23	28	26	34
Dacotah	Stand Rating	1	2.8	2.3	2.0	4.0	1.5
	Density Index	29	26	23	27	24	29

[a]Stand rating: 1 highest, 9 lowest.
[b]Density index: estimate of plant density, 40 = highest.

tion in mid-July to late August, depending on study site and year. Timing of precipitation had a greater impact on plant growth of Dacotah than Forestburg in this study.

Nutritional Quality

Location was more critical in crude protein (CP) and in vitro dry-matter digestibility (IVDMD) than variety in the GPNS. Nutritional quality (CP, IVDMD) was similar between Forestburg and Dacotah at both study locations (Hettinger and Fort Pierre); however, Fort Pierre had CP levels 4 percent to 6 percent lower than Hettinger throughout the growing season. The IVDMD also was similar between varieties, with initial quality 2 percent lower at Fort Pierre, compared with Hettinger; however, it was 18 percent lower by early October.

Switchgrass is nutritional and palatable for all classes of livestock in June and early July. The CP content drops below 10 percent by early July to early August, depending on location. Crude protein content was below 5 percent by early October when fully mature for both study locations. In vitro dry-matter digestibility of switchgrass was below 55 percent by early July at Fort Pierre and early October in Hettinger.

Table 23. Switchgrass biomass (lb/ac) range and average, mean biomass rank and phenology (1-9)[a] in early September (early August for Upham) at Upham, N.D.; Fergus Falls and Rochester, Minn.; Onida, Fort Pierre and Lake Andes, S.D.

Varieties	Performance	Upham	Fergus Falls	Rochester	Onida	Fort Pierre	Lake Andes
Summer	Biomass Range	5,410 – 9,426	4,024 – 9,011	3,849 – 4,931	1,468 – 9,140	837 – 6,101	6,376 – 9,322
	Biomass Average	6,910	6,821	4,511	4,234	3,239	7,711
	Biomass Rank	4	1	1	2	2	1
	Phenology	1	4	5	6	4	6
Sunburst	Biomass Range	4,848 – 9,639	4,703 – 9,113	3,063 – 4,323	1,901 – 7,221	578 – 5,320	5,808 – 6,398
	Biomass Average	7,499	6,794	3,646	4,060	2,763	6,162
	Biomass Rank	1	2	2	3	5	6
	Phenology	6	5	6	7	4	6
Pathfinder	Biomass Range	6,058 – 8,782	2,226 – 9,551	1,221 – 3,724	1,994 – 8,662	498 – 5,186	6,417 – 8,109
	Biomass Average	7,043	5,603	2,252	4,750	3,211	7,235
	Biomass Rank	3	4	6	1	3	3
	Phenology	3	3	4	5	3	5
Blackwell	Biomass Range	5,221 – 9,335	2,964 – 8,613	2,370 – 5,528	827 – 9,266	608 – 5,808	6,664 – 8,293
	Biomass Average	6,804	5,805	3,218	4,052	3,270	7,487
	Biomass Rank	5	3	4	4	1	2
	Phenology	3	3	5	5	2	5
Cave-in-Rock	Biomass Range	5,023 – 6,900	1,876 – 5,916	2,487 – 5,253	999 – 6,794	627 – 5,751	5,044 – 8,764
	Biomass Average	5,703	4,151	3,497	3,467	2,646	6,278
	Biomass Rank	7	5	3	5	6	4
	Phenology	3	3	5	5	4	5
Nebraska 28	Biomass Range	5,703 – 8,925	2,994 – 6,104	1,127 – 2,716	404 – 6,623	384 – 4,900	5,543 – 7,010
	Biomass Average	7,216	4,143	1,835	2,876	2,305	6,179
	Biomass Rank	2	6	8	7	8	5
	Phenology	6	5	6	7	4	7
Forestburg	Biomass Range	4,825 – 8,037	2,279 – 5,909	1,158 – 2,598	1,040 – 6,576	273 – 4,884	5,238 – 6,672
	Biomass Average	6,529	3,997	1,909	3,307	2,580	5,898
	Biomass Rank	6	7	7	6	7	7
	Phenology	6	5	6	7	5	6
Dacotah	Biomass Range	2,177 – 6,498	1,551 – 3,798	995 – 2,133	952 – 5,473	209 – 4,574	3,141 – 4,329
	Biomass Average	4,572	2,883	1,578	2,448	2,037	3,716
	Biomass Rank	8	8	9	8	9	8
	Phenology	8	8	7	8	7	8

[a]Phenology: 1 = vegetative; 2 = jointing; 3 = first emergence of inflorescence; 4 = first anthesis, 10 culms or more; 5 = 50% anthesis; 6 = first seed ripe; 7 = 50% seed ripe; 8 = seed mature; 9 = complete dormancy.

Fiber Content

Fiber content of switchgrass was lowest at the immature growth stage (early May), increasing through maturation and peaking at the end of the growing season. Acid detergent (ADF) and neutral detergent fiber (NDF) increased linearly throughout the growing season, with ADF peaking at 45 percent and 48 percent by early October for Forestburg and Dacotah, respectively. Neutral detergent fiber increased from 70 percent to 72 percent in early May to 74 percent to 78 percent in early October.

Forestburg ranked first and Dacotah second out of the 16 warm-season grass varieties studied in terms of average pounds of ADF and NDF produced per acre during the two-year period. Harvesting maximum levels of ADF and NDF of Forestburg occurs in early August, with 1,907 and 3,400 lb/ac of ADF and NDF, respectively. Harvesting maximum levels of ADF and NDF of Dacotah occurs in mid-September, with 1,531 and 2,599 lb/ac of ADF and NDF, respectively.

Grazing Value

Switchgrass will provide good grazing from June through August; however, palatability is lower than in most other native warm-season grasses. Proper grazing management is critical, with a stubble height of 8 to 12 inches required to assure stand longevity. Dacotah is the earliest maturing variety, with grazing recommended from mid-June through late July. Forestburg, Nebraska 28 and Sunburst were about 25 to 30 days later maturing than Dacotah and recommended for grazing from early July through August. Summer, Cave-in-Rock, Blackwell and Pathfinder were 45 to 60 days later in maturity than Dacotah and remained in a vegetative growth stage in August and much of September. When comparing growth patterns and nutritional value, livestock grazing from mid June through early August will optimize forage use and nutrient content. In vitro dry-matter digestibility was difficult to interpret but appears to be adequate through late August. A rotational grazing system can extend immature plant growth through early September, increasing nutritional quality and palatability. Switchgrass is reported to be toxic to horses, sheep and goats when grazing pure stands. Toxicity can cause photosensitivity and affect internal organs and liver function (USDA NRCS 2001/2002). No problems have been noted for cattle.

Switchgrass planted for pasture should be established as a pure stand because livestock tend to prefer other species if given a choice. Recommended varieties for livestock grazing in North and South Dakota and northern Minnesota are Forestburg, Dacotah and Sunburst. Recommendations for Nebraska, Iowa, southern Minnesota and southern South Dakota include Sunburst, Summer, Nebraska 28, Pathfinder, Trailblazer and Cave-in-Rock.

Recommended Grazing Season:
mid-June to early September (depending on variety).

Hay Value

Although not usually recommended for hay production, switchgrass can make fair to good hay, depending on timing of harvest and variety. It is palatable when immature; however, it becomes less desirable once maturation occurs and fiber increases. If establishing switchgrass as forage, grazing would be recommended, with hay use the alternative option. Proper harvest technique is critical, with a stubble height of 10 to 12 inches required to assure stand longevity.

Switchgrass should be cut by the late boot growth stage to maintain good CP (9 percent to10 percent) and IVDMD (> 55 percent) for winter feed and at flowering to maintain a CP and IVDMD level for nonlactating animals.

Suitable varieties for hay production in North and South Dakota and northern Minnesota are Forestburg, Dacotah and Sunburst. Recommendations for Nebraska, Iowa, southern Minnesota and South Dakota include Sunburst, Summer, Nebraska 28, Pathfinder, Trailblazer and Cave-in-Rock.

Recommended Haying Time:
mid to late July for a nonlactating ration that achieves a maintenance quality with optimum forage production and late June to early July for lactating ration, optimum quality,and lower production (variety dependant).

Wildlife Value

Switchgrass provides excellent year-round cover for a variety of wildlife species, including pheasants, white-tailed deer and rabbits. It provides high-quality nesting cover for grassland birds, especially pheasant and prairie grouse. Since switchgrass remains standing in heavy snow, it provides excellent winter thermal cover. Seeds provide food for pheasant, quail, turkey, dove and songbirds. Switchgrass provides fair to good forage value for white-tailed deer and some rodents in the immature growth stage but becomes unpalatable when mature.

Switchgrass should be seeded in a mixture with other native grasses, forbs and legumes to provide structure of various heights as habitat for grassland nesting birds and other wildlife species. Without proper management, cool-season invasive species (Kentucky bluegrass and smooth bromegrass) will become competitive, reducing habitat quality.

Cover Value
Spring: Excellent
Summer: Excellent
Fall: Excellent
Winter: Excellent

Forage Value
Spring: Good
Summer: Good
Fall: Fair
Winter: Poor

Seed field of forestburg switchgrass.

References

Borchers, G.A. 1980. **Soil Survey of Stanley County, South Dakota.** U.S. Department of Agriculture, Soil Conservation Service, U.S. Forest Service, U.S. Department of the Interior, Bureau of Indian Affairs and South Dakota Agricultural Experiment Station. 135 p.

Phillips Petroleum Company. 1963. **Pasture and Range Plants.** Library of Congress Catalog. 175 p.

Sedivec, K.K., and W.T. Barker. 1997. **Selected North Dakota and Minnesota Range Plants.** NDSU Extension Service. Fargo, N.D.

Sedivec, K.K., and J.L. Printz. 2005. **Ranchers Guide to Grassland Management III.** North Dakota State University and USDA NRCS. 267 p.

Sedivec, K., D. Tober and J. Berdahl. 2001. **Grass Varieties for North Dakota.** NDSU Extension Service R-794 (Revised). Fargo, N.D. 20 p.

Sedivec, K.K., D.A. Tober, W.L. Duckwitz, D.D. Dewald and J.L. Printz. 2008. **Grasses for the Northern Plains, growth patterns, forage characteristics and wildlife values. Volume I — cool-season.** NDSU Extension Service R-1323. Fargo, N.D. 89 p.

Twidwell, E., A. Boe, R. Pollman and D. Schmidt. 1997. **Available Grass Varieties for South Dakota.** SDSU Cooperative Extension Service 890. Brookings, S.D. 26 p.

Ulmer, M.G. and J. Conta. 1987. **Soil Survey of Adams County, North Dakota.** U.S. Department of Agriculture, Natural Resources Conservation Service, Bismarck, N.D.

USDA NRCS. 1983, 1984, 1985, 1986/1987, 1988/1989, 1990/1991, 1992/1993. **Technical Report, Part 1: Grasses, Forbs, and Legumes.** Plant Materials Center, Bismarck, N.D.

USDA NRCS. 1997. Field evaluation planting, pages 61-88. **In: Technical Report, 1994-1997, Part 1 of 2: Grasses, Forbs, and Legumes.** Plant Materials Center, Bismarck, N.D.

USDA SCS. 1994. **Grass Varieties in the United States.** Agric. Handbook No. 170. Washington, D.C. 296 p.

USDA NRCS 2001/2002. Switchgrass toxicity/photosensitivity in horses, sheep, and goats. **In: Northland News.** p. 6.

USDA NRCS. 2007. **Improved Conservation Plant Materials Released by NRCS and Cooperators Through December 2007.** National Plant Materials Center, Beltsville, Md. 64 p.

USDA NRCS. 2006. **Herbaceous vegetation establishment guide.** Field Office Technical Guide (FOTG), North Dakota, Sec.1, Reference Subject, Plant Materials, 21 p.

USDA NRCS. 2008. The PLANTS database, [Online]. Baton Rouge, La.: National Plant Data Center. Available: http://plants.usda.gov.

For more information on this and other topics, see: **www.ag.ndsu.edu**

County commissions, North Dakota State University and U.S. Department of Agriculture cooperating. North Dakota State University does not discriminate on the basis of race, color, national origin, religion, sex, disability, age, Vietnam Era Veterans status, sexual orientation, marital status, or public assistance status. Direct inquiries to the Chief Diversity Officer, 205 Old Main, (701) 231-7708. This publication will be made available in alternative formats for people with disabilities upon request, (701) 231-7881.

10M-6-09