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EC98-149 Summer Annual Forages for the Nebraska Panhandle: Variety Tests, 1989-1992 and 1997

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SUMMER ANNUAL FORAGES FOR THE NEBRASKA PANHANDLE

VARIETY TESTS, 1989-1992 AND 1997

Agricultural Research Division
Cooperative Extension
Institute of Agriculture and Natural Resources
University of Nebraska

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Summer Annual Forages for the Nebraska Panhandle

Variety Tests, 1989-1992 and 1997

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Acknowledgment

This circular is a summary report of summer annual forage trials conducted in 1989-92 and 1997 to obtain forage production and quality data. Dryland trials were conducted at the High Plains Agricultural Laboratory near Sidney. Irrigated trials were at the Panhandle Research and Extension Center at Scottsbluff. Seed producers supported tests through fee payments. Conduct of the trials and publication of results are joint efforts of the Agricultural Research Division and the Cooperative Extension Service.

We want to thank the people who provided technical support, especially Glen Frickel and Ray Weed for trial maintenance and data analysis. Clerical support by Sharon Holman was very helpful.

Metric Equivalents

1 centimeter = 0.394 inches	cm = inches x 2.54
1 hectare = 2.471 acres	ha = acres x 0.405
1 kilogram = 2.205 pounds	kg = pounds x 0.454

Definitions

Metric tons/hectare = pounds/acre ÷ 2205 x 2.471

LSD = A statistic (calculated at the 5 percent probability level in this book) used to compare the difference between two entries for significance. If the difference between two entries is larger than the LSD value at the bottom of each table, it is assumed significant and repeatable in 95 percent of such comparisons.

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Summer Annual Forages for the Nebraska Panhandle Variety Tests 1989-92 and 1997

Summer annual forage grasses can provide valuable forage as pasture, green chop, silage, and hay. With adequate soil moisture these forages grow very rapidly during warm summer months. Most varieties are relatively drought resistant because of efficient water use. Summer annual forage grasses vary greatly in: 1) plant height, 2) regrowth potential, 3) stem diameter, 4) antiquality and toxic components, 5) yield, and 6) growing season both between types of grasses and within varieties of a given type. It is important to select a type and variety most suitable to the system in which it is to be used. Nebraska producers have relied primarily on six types of summer annual forage grasses to meet or supplement forage needs.

Summer Annual Forage Types

Forage sorghum includes open-pollinated and hybrid varieties. Forage sorghum is a coarse, erect grass with considerable variability in growth characteristics. Some cultivars tiller early, while others do not tiller until late in the season. Stem diameter varies from 0.25 inch to over an inch, depending on genotype and planting density. They are frequently referred to as "cane" or "sweet cane" or by the particular variety name with no mention of type. Forage sorghums usually yield more silage dry matter per acre than dryland corn, but yields of total digestible nutrients (TDN) usually are lower for the forage sorghums, especially under irrigation. Since forage sorghums generally have the potential to form high levels of prussic acid, do not graze them prior to plant death. The standing material can be grazed during the winter. Forage sorghums often are cut for hay, but stem thickness delays drying following cutting. This can be partially offset by the use of heavier seeding rates and variety selection. Harvesting equipment that includes a crimper or conditioner should also speed drying.

Sudangrass is a relative of the sorghums and recently has been given the same taxonomic name as sorghums (*Sorghum bicolor*). It is generally differentiated in the trade by its relatively low prussic acid content, fine stems, tillering, and regrowth potential. It also has both open-pollinated and hybrid varieties. The hybrids have more yield potential in a multiple-cut harvest system. Prussic acid content varies among sudangrass varieties and can be influenced by management, especially with hybrids. Always check the potential prussic acid levels before buying seed if the planned use is for grazing or green chop.

Sorghum x sudangrass is the most commonly used summer annual forage type in Nebraska. It is high yielding, but much of this yield is stem material so mature forage can be low in energy and protein. Rate of regrowth after clipping or grazing generally is lower than in sudangrass but sorghum x sudangrass can be used for grazing, green chop or multiple-cut hay operations. Depending on characteristics of the sudangrass and sorghum parent lines, there can be large variations in these hybrids. Always check the traits needed for your production system before buying seed.

Foxtail millet is better adapted to the western portion of the state because it has a short growing season and drought tolerance. Grazing potential is limited because it is frequently pulled from the ground by grazing animals and regrowth is limited. It drys faster and with fewer mold problems than other summer annuals, which are almost all thicker stemmed. Foxtail millet is used primarily for hay production. However, it can be cut in the fall and left in windrows for fall or winter grazing which eliminates many utilization costs. Cows will find the hay in the windrows even with some snow cover after they know it is there. Foxtail millet is a known host for the wheat curl mite, which is the carrier wheat streak mosaic virus. Caution is needed when planting it beside fields that will be seeded to wheat in the fall. Always cut or destroy foxtail millet before planting wheat. Planting wheat after the first killing frost will eliminate this disease problem when wheat is seeded next to a foxtail millet field.

Proso millet was not developed as a forage crop, but frequently has been planted as one. It produces forage similar in quality to other summer annuals, but yield is lower so it should be grown for its grain potential instead. The variety 'Sunup' produces more forage than 'Dawn' or 'Rise'. Most proso grown for grain is swathed prior to full maturity and then combined, resulting in straw of relatively high feed value compared to other grain crops that have lost most of their leaves prior to harvest. Proso straw has been used successfully as part of the feed for wintering dry pregnant beef cattle. It is **not** a major host of the wheat curl mite and is not high in prussic acid.

Pearl millet planted for grazing has increased in Nebraska due to new and better adapted varieties. It can be grown as a hay crop, but its slow dry-down and coarse stems make some other summer annuals more desirable for this purpose. Stem diameter can be reduced by increasing seeding rates or harvesting earlier. New hybrids may have good potential for green chop because of low levels of prussic acid. It appears that its primary use will be for summer grazing for ruminants.

High Plains Trials

Dryland Trials

Summer annual forage types were tested for production under dryland conditions in western Nebraska during the 1989-91 growing seasons. They were planted on June 28, 1989, June 27, 1990 and June 24, 1991 and were harvested in late August or early September, depending on maturity. With the short growing season and limited rainfall in this environment, tillering and regrowth potential are much less important than further east.

The dryland forage trials were established at the High Plains Ag Lab six miles northwest of Sidney, Nebraska. The entries consisted of sorghum, sudangrass, sorghum x sudangrass, foxtail, proso, and pearl millet varieties. The plot design was a randomized complete block with four replications. Individual plots were 6 feet wide and 24 feet long. Plots were planted with a double disc grain drill with a cone seed distribution system. The drill was six rows wide with 12 inch row spacing. Starter fertilizer of 9 lb/a nitrogen and 32 lb/a phosphorus was applied at planting time. The soil was an Alliance loam (fine-silty mixed, Mesic Aridic Argiustolls).

Immediately before harvest, a maturity score was assigned and stem diameter and plant height were measured. At each harvest date a 3- by 16-foot area was cut with a flail mower and weighed for a yield estimate before subsampling for moisture determination and analysis for crude protein (CP), in vitro dry matter digestibility (IVDMD) and nitrate.

Dry matter yield, percent dry matter, maturity score, plant height, and stem diameter at harvest are shown in *Tables 1-5*. Digestibility, crude protein and nitrate values are summarized in *Tables 6-10*. Nitrate nitrogen levels were determined in the 1989 and 1990 trials with few samples approaching the level of 2,100 ppm, which is considered the starting level for nitrate toxicity potential. All of these forages should be monitored carefully for nitrate levels under high nitrogen fertility growing conditions and/or late season drought.

In addition, a dryland plot of foxtail millet was planted on July 11, 1997 to simulate the planting date some farmers might use for foxtail millet after an early harvest of a small grain crop or a crop failure due to weather or pests. Four foxtail millet varieties: Manta, Manta 99, White Wonder and Golden German were planted in 4 replications with a double disc drill in a field where wheat had been harvested the previous year. The plot was hailed on August 19, resulting in considerable damage to Manta and Manta 99 which were heading, but not as much damage to the other two varieties. The plot was harvested on September 19 by cutting replicated 4- by 10-foot strips for a yield sample, followed by subsampling and drying for quality analysis at a laboratory.

Results are shown in *Table 16*. Each Manta variety had one subplot that yielded below the other three subplots, otherwise they would have yielded close to Golden German in this season with hail damage. The combination of planting date, hail and rainfall amounts limited the amount of production in a 60-day growing season in late summer. Although the Mantas matured earlier than the other two varieties and had slightly higher crude protein contents, all varieties exceeded the protein and available energy contents of many average quality grass hays produced from perennial grasses.

Randy Anderson (USDA) and Dave Schutz (CSU) planted foxtail millet at the USDA Central Great Plains Research Station near Akron, Colorado in early June 1996 and harvested it at the early milk stage. As reported in the January 1998 issue of USDA Agricultural Research, Golden German yielded up to 6100 pounds of dry matter per acre while Manta yielded about 3800. However, Manta had 13 percent crude protein compared to 10 for Golden German and two other varieties, White Wonder and Butte. Manta matured about three weeks earlier than the other three varieties. Similar yield data for Golden German and White Wonder cultivars have been obtained in Nebraska trials with similar planting dates, depending on the year and weather.

Irrigated Trials

On June 20, 1991 and June 12, 1992, irrigated forage trials were established at the Panhandle Research and Extension Center at Scottsbluff, Nebraska. The trials included foxtail millet, sorghum, sorghum x sudangrass, and pearl millet varieties. Production data are shown in *Tables 11-13*. Quality data are shown in *Tables 11, 14* and *15*.

The plots were planted with a double disc grain drill with a cone seed distribution system for 12" row spacing. The plot size was 6 feet by 20 feet with four replications. Starter fertilizer consisting of 9 lb/a nitrogen and 32 lb/a phosphorus was applied at planting. The entire plot area received 60 and 80 lb/a of nitrogen in 1991 and 1992, respectively, about three weeks after planting. The soil was a Tripp very fine sandy loam with a pH of 8.1. In-season soil test results showed adequate amounts of nitrogen, phosphorus, potassium, zinc, manganese, and copper so no additional nutrients were applied. Iron was medium to low.

Chlorosis was noted in many varieties at early growth stages in 1991, which was likely due to the high soil pH and lower amounts of iron. Adjacent areas of proso millet recovered when sprayed twice with a 3.25 percent chelated liquid iron solution mixed at the rate of 2 tablespoons per gallon of water. The small seeded millets (proso and foxtail) established poorly in 1992 due to heavy rain after planting.

The plot area was irrigated as needed during the growing season. Plots were harvested on August 1, 1991 and August 13, 1992, followed by irrigation and regrowth until final harvest was made on September 23, 1991 or October 5, 1992. In 1992 an additional trial was planted on June 12 and harvested in a one-cut system on October 5 when the regrowth trial was harvested. Plots were trimmed to 16 feet and harvested with a flail forage harvester. At each harvest date a 3- by 16-foot area was cut for a yield sample. The initial harvest was cut at 6 inches to encourage faster regrowth and the last harvest was cut at 2 inches to maximize yield. The harvested amount was weighed and a subsample was collected for moisture determination and analysis for crude protein (CP) and in vitro dry matter digestibility (IVDMD). In 1992 additional analyses were done for nitrate nitrogen, acid detergent fiber (ADF) and neutral detergent fiber (NDF).

On June 17, 1997, an experimental hybrid pearl millet, which has since been released as Mega Mil, was planted into an irrigated plot at the Panhandle Research and Extension Center, Scottsbluff, Nebraska. This crop was planted in rows 30 inches apart and irrigated with a lateral move sprinkler as needed. A forage yield sample was taken from two ten-foot sections of row on September 26 when this variety had reached a height of 6 to 8 feet. Subsamples were taken for dry matter and forage quality testing. Results are shown in *Table 17*. Yield estimates were 7 to 8 tons of dry matter per acre, which would be as high as typical corn silage yield when harvested at 35 percent DM. The forage dry matter estimates when harvested seemed rather low (17 percent), but

consistent with a tall hybrid that has many leaves. This pearl millet hybrid cut after 101 days of growth contained 11 percent crude protein and 55 percent TDN, equivalent in feed value on a dry matter basis to many midbloom grass hays. Cutting after 80 to 90 days of growth would have increased the protein and available energy contents but decreased dry matter yield, a compromise that may be desirable depending on the needs of the target animals involved. Nitrate contents were not tested in 1997 samples, but are not often a problem in summer annual grasses when crude protein is at 11 percent or less because this is indicative of growing conditions that achieve normal plant growth and maturity.

Animal Health Factors

Caution should be used when summer annual grasses are grazed or fed. Monitor nitrate levels closely with all of these crops before feeding. Ensiling high nitrate summer annual forages can help reduce nitrate problems. As nitrate nitrogen levels increased above 2100 ppm in the 1992 forage samples from the irrigated regrowth trial *(Table 14)*, there would be increased risk for nitrate toxicity in animals. These forages should be fed or grazed along with low nitrate forage fed or grazed and not fed to pregnant animals. However, cattle grazing high nitrate forage tend to selectively graze the plant leaves which are lower in nitrate than the lower parts of the plant. If they are forced to graze stem bases that are high in nitrate, the risk of nitrate toxicity will increase.

The potential for formation of prussic acid (also called hydrocyanic acid) is high in most sorghums, high at times in sudangrass (especially in regrowth following a frost, grazing or haying), and high at times in sorghum-sudangrass crosses (especially some particular hybrids). It is not a problem with foxtail, proso or pearl millet. Prussic acid interferes with oxygen utilization, with mild cases causing labored breathing, frothing at the mouth, or staggering, and severe cases causing death.

Horses should not eat large quantities of forage sorghums, sorghum x sudangrass hybrids, or foxtail millets. Horses consuming these forages as a major component of their diet frequently develop urinary, liver or bone problems due to a specific glucoside component of the forage that is not a problem for cattle. However, pearl millet can be utilized effectively by horses because it does not have this component. Inadequate curing or drying of summer annual grasses can lead to molds that can increase risk of respiratory reactions in horses.

Change livestock rations carefully, especially when changing the forage component to summer annuals. Animals should not be hungry when first exposed to summer annuals and supplemental nutrients including water should be adequate. Observe animals closely for any signs of distress developing during the first few days and switch to other feed if necessary.

Forage Quality Considerations

Quality is negatively correlated with maturity in summer annual forages. As maturity increases quality declines rapidly. This includes decreases in protein content, energy value and intake, which can drop considerably with the coarser stemmed types. High forage protein and digestible energy levels can be obtained by harvesting these forages prior to heading, preferably at the late boot stage. The optimum compromise between quality and yield generally occurs shortly after seed heads have emerged. Yield (dry matter per acre) may increase by 10 percent to 20 percent from the boot to the early heading stages. Forage must be harvested prior to the soft dough stage of seed development if anything more than roughage is required. Foxtail and proso millet maintain forage quality slightly longer than the sorghum relatives, but still need to be harvested when most of the seed heads have emerged to maximize quality. Foxtail millet harvested after flowering may develop stiff awns that can cause mouth injuries to animals eating the hay.

Grazing should be initiated at an earlier plant stage than selected for haying because advanced maturity will decrease regrowth potential. Intensive grazing with rotation of pastures maximizes harvest efficiency and beef production per acre. The grazing season can be lengthened and forage quality maintained if planting dates are staggered. Trampling can be reduced by using wider row spacing and higher rates of seed per row.

Winter grazing of summer annuals is more practical in western Nebraska than in areas with higher levels of precipitation and humidity that cause forage deterioration. Forage quality can be maximized by delaying planting so that the crop is killed by frost before flowering. This will also improve standability of the forage during winter storms.

Information Resources

Extension publications including NebGuide G86-775, *Prussic Acid Poisoning*, NebGuide G74-170, *Nitrates in Livestock Feeding*, and NebGuide G74-171, *Summer Annual Forage Grasses*, are available through Cooperative Extension offices in Nebraska counties or other University of Nebraska Institute of Agriculture and Natural Resources locations. These NebGuides and this publication provide management information to help make forage selections and to minimize the risk of animal toxicity from prussic acid or nitrate released during digestion of summer annual grasses with high levels of these components. Additional trials with summer annual grasses will be initiated in 1998 using current varieties to test for similar production and quality data. Protein degradability in the rumen of cattle will also be determined to create a data base for the new metabolizable protein system released in the 1996 Nutrient Requirements for Beef Cattle by the Subcommittee on Beef Cattle Nutrition for the National Research Council. A manual and computer software that enable application of these requirements can be purchased from the National Academy Press, 2101 Constitution Avenue, NW, Lockbox 285, Washington DC 20055 (1-800-624-6242).

Table 1. Production of dryland forage sorghum grown at High Plains Ag Lab (HPAL), Sidney, NE, 1989-1991.

	DM Yield (lb/acre)			Dry Matter (percent)			Height (inches)			Stem Diameter (inches)			Maturity[a] (score)		
Cultivar	**89**	**90**	**91**	**89**	**90**	**91**	**89**	**90**	**91**	**89**	**90**	**91**	**89**	**90**	**91**
Super Sile 20	6500			22			67			.43			1.0		
Titan MS		2710			31			44			.43			2.0	
Early Sumac	6390	3270		23	32		69	45		.40	.40		1.7	2.2	
X-982[b]		2870			30			39			.54			2.2	
Super Ster. 30	6030			21			61			.37			1.2		
X-15645[b]		3070			29			51			.53			2.2	
Sweet-N-Red	5550	2920		21	31		73	47		.40	.37		2.0	2.2	
NK300		3160	7970		39	40		36	42		.46	.41		2.7	2.5
Canex	5540	850		21	31		72	48		.40	.43		2.2	2.2	
Leoti	5450	2400		22	29		69	43		.43	.46		2.0	2.2	
MorCane	5280	2640	5440	20	30	30	68	48	59	.41	.58	.34	2.0	2.5	1.5
Sumac Cane	4760			18			73			.46			2.0		
Rox Orange	4710	2300		19	23		63	47		.40	.43		1.0	2.2	
FS-5		3210			32			50			.57			2.0	
877F		2710			34			60			.45			3.0	
956		2660			32			47			.46			2.0	
St-6E		2510			36			64			.28			3.0	
Sterile HYB		2500			29			47			.63			2.0	
Sorgo 10		2500			29			46			.36			2.7	
J62			7610			37			37			.48			2.3
J71			6850			32			32			.47			1.8
Average	5580	2770	6970	21	31	35	68	47	42	.41	.46	.43	1.7	2.3	2.0
LSD 0.05	790	361	1800	3	3	3	6	2	8	.09	.06	.08	.4	.2	.6

[a]Maturity score is based on 1=vegetative, 2=boot, 3=headed, 4=soft dough, and 5=mature seed.
[b]X = experimental cultivar at the time this trial was conducted.

Table 2. Forage production of dryland sorghum x sudan and sudangrass hybrids grown at HPAL, Sidney, NE, 1989-1991.

	DM Yield (lb/acre)			Dry Matter (percent)			Height (inches)			Stem Diameter (inches)			Maturity[a] (score)		
Cultivar	**89**	**90**	**91**	**89**	**90**	**91**	**89**	**90**	**91**	**89**	**90**	**91**	**89**	**90**	**91**
Sweet Sioux	6600	2440	5650	25	35	36	75	60	63	.37	.38	.39	1.8	2.0	2.8
Super Sweet 10	5780			24			70			.31			2.8		
Cattlegrazer	5750	2480		27	37		78	66		.50	.38		2.0	3.0	
Piper	5520	2360		31	47		74	60		.50	.38		2.0	3.0	
Honey Graze II	5430			24			72			.40			2.0		
SSB8001	5390			23			73			.43			2.0		
Grazex	4980	2510		26	39		83	70		.40	.37		2.3	3.0	
SSII	4850			23			74			.37			2.0		
Buffalo VNS	4650	2510		23	35		76	61		.43	.38		2.0	3.0	
Sweet Sunny Sioux		2750			36			57		.35				3.0	
Trudan 8		2660	5520		38	25		59	60		.37			3.0	3.0
Grazer SG		2470			37			57			.34			3.0	
Sordan 79		2450	7270		34	37		51	69		.37	.34		3.0	3.0
Greentreat II		2440			41			69			.35			3.0	
SSX584		2190			38			56			.38	.42		2.5	
SSX84		1970			37			61			.35			2.7	
JX Sue			7150			37			68			.38			3.0
Super Sugar			7040			39			72			.39			3.5
SiouxDan HS35			5260			26			62			.22			3.0
Average	5440	2440	6320	25	38	33	75	61	66	.38	.37	.36	2.1	2.9	3.1
LSD 0.05	790	320	1800	3	1	3	6	4	8	.09	.04	.08	.4	.3	.6

[a]Maturity score is based on 1=vegetative, 2=boot, 3=headed, 4=soft dough, and 5=mature seed.

Table 3. Forage production of dryland pearl millet grown at HPAL, Sidney, NE, 1989-1991.

	DM Yield (lb/acre)			Dry Matter (percent)			Height (inches)			Stem Diameter (inches)			Maturity[a] (score)		
Cultivar	**89**	**90**	**91**	**89**	**90**	**91**	**89**	**90**	**91**	**89**	**90**	**91**	**89**	**90**	**91**
Giant Millet	6590			24			56			.24			2.0		
Millex	6590	2510		24	34		65	44		.24	.34		3.0	3.0	
X-006[b]	5250	2300		24	31		36	29		.24	.31		1.0	1.7	
Dixieland HYGR	5090	2570		22	30		45	36		.22	.30		1.5	2.5	
MorCane[c]	5030			21			68			.21			2.0		
Millex 24		3080	6400		30	34		40	43		.30	.28		2.5	1.8
J45			6320			34			42			.34			1.8
Tift 23 DAE FPM	4310			20			48			.20			1.0		
X-Leafy[b]	4230			22			34			.40			1.3		
Tifleaf II	4140			22			32			.22			1.0		
Tift 85A FPM	2820	2610		22	30		37	34		.22	.30		2.0	1.0	
FPM-Bulk	2820	2290		24	31		32	31		.24	.31		1.0	1.7	
Sunny State HPM		3030			31			37			.31			2.5	
Pearl HYB 1470		2970			32			38			.32			2.2	
X-Mill 1[b]		2860			31			38			.31			3.0	
X-Mill 2[b]		2690			29			37			.29			2.2	
Mill HYB 300		2580			29			36			.29			2.7	
Tifleaf 20		2070			28			24			.28			2.0	
Leafy 20		1880			29			25			.29			1.7	
X-8888[b]			5920			35			49			.29			2.8
Average	5100	2570	6210	23	31	34	50	35	45	.23	.30	.30	1.6	2.2	2.1
LSD 0.05	1130	343	1800	3	2	3	9	3	8	.09	.06	.08	.5	.4	.6

[a]Maturity score is based on 1=vegetative, 2=boot, 3=headed, 4=soft dough, and 5=mature seed.
[b]X = experimental cultivar at the time this trial was conducted.
[c]MorCane is a forage sorghum included as a check.

Table 4. Forage production of dryland foxtail millet grown at HPAL, Sidney, NE, 1989-1991.

	DM Yield (lb/acre)			Dry Matter (percent)			Height (inches)			Stem Diameter (inches)			Maturity[a] (score)		
Cultivar	**89**	**90**	**91**	**89**	**90**	**91**	**89**	**90**	**91**	**89**	**90**	**91**	**89**	**90**	**91**
Golden German	5760	2800	6760	23	40	40	33	32	26	.22	.20	.20	2.0	3.0	2.5
Siberian Red	5720			33			32			.13			4.0		
Siberian Millet	5660	1690	4860	33	28	30	30	30	28	.22	.21	.18	4.0	3.0	4.0
Hungarian Millet	5490	1420	5230	36	27	33	33	30	29	.13	.10	.16	4.0	2.5	4.0
White Wonder	5280	2560	6140	23	32	37	34	31	24	.25	.18	.19	2.0	2.5	2.3
German R Millet	3650	2950	5070	23	36	31	32	31	22	.25	.18	.17	2.0	2.5	1.0
Average	5257	2280	5610	28	33	34	32	31	26	.18	.18	.18	3.0	2.7	2.8
LSD 0.05	520	798	1837	3	5	3	2	3	8	.07	.08	.08	.4	.6	.6

[a]Maturity score is based on 1=vegetative, 2=boot, 3=headed, 4=soft dough, and 5=mature seed.

Table 5. Forage production of dryland proso millet grown at HPAL, Sidney, NE, 1989-1991.

	DM Yield (lb/acre)			Dry Matter (percent)			Height (inches)			Stem Diameter (inches)			Maturity[a] (score)		
Cultivar	**89**	**90**	**91**	**89**	**90**	**91**	**89**	**90**	**91**	**89**	**90**	**91**	**89**	**90**	**91**
Sunup	4920	1840	5220	31	27	28	29	28	32	.25	.21	.18	4.0	3.0	4.0
Japanese			5660			33			27			.25			1.0
Panhandle	4660	1580		33	27		33	32		.25	.21		4.0	3.5	
Rise	4410	1590		31	26		28	29		.25	.21		4.0	3.2	
Dawn	3680	1040		36	27		23	27		.16	.25		5.0	4.0	
Average	4430	1510	5440	33	26	31	28	28	30	.23	.22	.22	4.3	3.4	2.5
LSD 0.05	560	604	1800	2	3	3	2	3	8	.05	.08	.08	.4	.5	.6

[a]Maturity score is based on 1=vegetative, 2=boot, 3=headed, 4=soft dough, and 5=mature seed.

Table 6. Forage quality of dryland forage sorghum grown at HPAL, Sidney, NE, 1989-1991.

	Crude Protein (percent)			Nitrate N (ppm)		IVDMD[a] (percent)		
Cultivar	**89**	**90**	**91**	**89**	**90**	**89**	**90**	**91**
Super Sile 20	10.4			730		62		
Titan MS		8.7			990		63	
Early Sumac	10.7	10.2		420	460	65	64	
X-982[b]		10.1			770		60	
Super Ster. 30	11.6			660		66		
X-15645[b]		9.0			670		62	
Sweet-N-Red	10.9	9.2		530	500	64	64	
NK300		8.9	10.2		610		58	61
Canex	12.0	9.1		1160	790	64	63	
Leoti	12.0	9.0		380	910	67	65	
MorCane	11.9	9.2	9.4	790	720	65	60	68
Sumac Cane	13.4			1100		59		
Rox Orange	11.2	9.4		670	610	65	63	
FS-5		9.7			780		62	
877F		9.5			770		61	
956		9.6			550		64	
St-6E		10.5			1140		60	
Sterile HYB		9.2			1420		61	
Sorgo 10		9.0			1640			63
J 62			9.2					66
J 71			9.7				65	
Average	11.9	9.4	9.6	710	830	62	62	64.5
LSD 0.05	2.8	1.4	1.7	800	499	5.4	4	—

[a]IVDMD = in vitro dry matter digestibility.
[b]X = experimental cultivar at the time this trial was conducted.

Table 7. Forage quality of dryland sorghum x sudan and sudangrass hybrids grown at HPAL, Sidney, NE, 1989-1991.

	Crude Protein (percent)			Nitrate N (ppm)		IVDMD[a] (percent)		
Cultivar	**89**	**90**	**91**	**89**	**90**	**89**	**90**	**91**
Sweet Sioux	11.0	9.9	8.1	490	980	60	62	64
Super Sweet 10	10.7			620		58		
Cattlegrazer	13.6	9.9		520	810	60	64	
Piper	12.9	9.0		180	430	58	57	
Honey Graze II	13.9			690		60		
SSB8001	12.7			430		63		
Grazex	12.6	9.2		790	810	58	60	
SSII	12.1			680		61		
Buffalo VNS	13.3	10.8		1160	830	66	63	
Sweet Sunny Sioux		9.8			820		61	
Trudan 8		10.7	12.6		870		65	62
Grazer SG		10.0			920		65	
Sordan 79		10.7	8.8		1420		65	60
Greentreat II		10.7			730		64	
SSX584		10.2			890		61	
SSX84		11.1			1120		61	
JX Sue			8.2					61
Super Sugar			8.6					62
SiouxDan HS35			10.9					68
Average	12.5	10.2	9.5	620	940	60	63.7	63
LSD 0.05	2.9	1.8	1.9	800	598	5.4	6.0	—

[a]IVDMD = in vitro dry matter digestibility.

Table 8. Forage quality of dryland pearl millet grown at HPAL, Sidney, NE, 1989-1991.

Cultivar	Crude Protein (percent)			Nitrate N (ppm)		IVDMD[a] (percent)		
	89	90	91	89	90	89	90	91
Giant Millet	11.0			480		60		
Millex	10.0	10.4		250		58		
X-006[b]	12.9	11.9		560	880	61	60	
Dixieland HYGR	11.4	11.5		590	1360	61	59	
MorCane[c]	11.3			1350		61		
Millex 24		9.7	9.3		1010		58	66
J45			9.3	370			66	
Tift 23 DAE FPM	10.6			230		62		
X-Leafy[b]	11.9			400		62		
Tifleaf II	13.2			170		62		
Tift 85A FPM	11.7			1370	1290		61	
FPM-Bulk	14.5	12.3			870	68	62	
Sunny State HPM		9.9			870		62	
Pearl HYB 1470		11.0			1360		58	
X-Mill 1[b]	11.9			1580		58		
X-Mill 2[b]		11.8			1090		60	
Mill HYB 300		11.3			620		62	
Tifleaf 20		11.2			1720		67	
Leafy 20		13.4					61	
X-8888[b]			9.7					70
Average	11.9	11.3	9.5	590	1160	62	60.6	68
LSD 0.05	1.0	1.6	1.2	480	873	2.5	7.9	—

[a]IVDMD = in vitro dry matter digestibility.
[b]X = experimental cultivar at the time this trial was conducted.
[c]MorCane is a forage cane rather than pearl millet that is included as a check.

Table 9. Forage quality of dryland foxtail millet grown at HPAL, Sidney, NE, 1989-1991.

Cultivar	Crude Protein (percent)			Nitrate N (ppm)		IVDMD[a] (percent)		
	89	90	91	89	90	89	90	91
Golden German	11.7	9.8	10.4	1350	1360	54	59	68
Siberian Red	10.4			610		50		
Siberian Millet	11.6	13.1	11.8	903	1630	56	61	69
Hungarian Millet	10.5	13.8	12.0	955	1350	56	62	67
White Wonder	12.6	9.6	11.2	1362	1090	58	59	68
German R Millet	12.5	11.0	12.5	1218	1150	55	57	65
Average	11.6	11.5	11.6	1066	1320	55	60	67
LSD 0.05	1.0	1.3	1.1	478	481	2.6	3.9	—

[a]IVDMD = in vitro dry matter digestibility.

Table 10. Forage quality of dryland proso millet grown at HPAL, Sidney, NE, 1989-1991.

Cultivar	Crude Protein (percent)			Nitrate N (ppm)		IVDMD[a] (percent)		
	89	90	91	89	90	89	90	91
Sunup	11.4	14.1	11.9	970	2250	52	58	62
Japanese			11.2					65
Panhandle	9.9	14.0		1260	2130	50	55	
Rise	11.7	14.5		1140	2210	57	59	
Dawn	10.3	14.4		550	2490	50	55	
Average	10.8	14.3	11.5	980	2270	52	57	63.5
LSD 0.05	1.2	.7	1.2	1030	527	5.9	3.1	—

[a]IVDMD = in vitro dry matter digestibility.

Table 11. Forage production and quality of irrigated summer annual forages grown at PHREC[a], Scottsbluff, NE, in a regrowth trial, 1991.[b]

Crop	Cultivar	DM Yield (lb/acre)			Dry Matter (percent)		Crude Protein (percent)		IVDMD[c] (percent)	
		1st cut	2nd cut	Total	1st cut	2nd cut	1st cut	2nd cut	1st cut	2nd cut
Pearl Millet	J45	3410	5830	9240	19	38	13.5	9.1	58	57
Sorghum x Sudan	Sweet Sioux V	2650	6300	8950	18	41	12.7	8.6	.54	53
Sorghum x Sudan	Sweet Sunny Sioux	2920	4640	7560	17	37	13.0	9.2	54	53
Sorghum x Sudan	Grazex	2780	4580	7360	18	37	11.9	8.8	58	55
Sorghum x Sudan	Greentreat II	3360	3600	6960	23	42	10.5	8.9	50	52
Pearl Millet	Sunny States HPM	3100	3480	6580	19	41	14.7	9.0	61	56
Sorghum x Sudan	Greentreat II	3230	3330	6560	18	45	13.4	8.6	57	52
Sudangrass	SiouxDan HS35	1990	4500	6490	18	40	11.6	8.9	60	54
Sorghum x Sudan	Super Sugar	2130	4230	6360	22	38	15.2	8.9	56	52
Sorghum x Sudan	Grazex II	2530	3440	5970	16	40	13.9	8.6	54	51
Forage Sorghum	NK300	3490	—	3490	22	—	13.8	—	58	—
Sorghum x Sudan	SS*87 Brown Midrib	1380	1760	3240	22	40	12.8	8.6	55	61
Forage Sorghum	FS5	3030	—	3030	18	—	13.2	—	53	—
Proso Millet	Japanese	1110	1870	2980	29	42	17.0	8.9	55	56
Foxtail Millet	Siberian	2800	—	2800	26	—	13.9	—	55	—
Foxtail Millet	White Wonder	1590	1100	2690	27	44	15.1	8.5	61	54
Forage Sorghum	MorCane II	2550	—	2550	16	—	13.5	—	55	—
Forage Sorghum	FS2	2530	—	2530	19	—	13.6	—	58	—
Foxtail Millet	Hungarian	2220	—	2220	27	—	13.4	—	57	—
Foxtail Millet	Golden German	2130	—	2130	24	—	12.5	—	61	—
Proso Millet	Sunup	2060	—	2060	22	—	12.8	—	54	—
Foxtail Millet	German R	1780	—	1780	22	—	13.8	—	60	—
Sorghum x Sudan	Buffalo VNS	1720	—	1720	16	—	14.1	—	53	—
	Average	2460	3740	4570	21	40	13.4	8.8	56.3	54.3
	LSD 0.05	1150	1650	1680	5.0	7.4	3.1	.89	9.1	5.3

[a]PHREC = Panhandle Research and Extension Center, University of Nebraska.
[b]Blank spaces indicate that little or no regrowth occurred.
[c]IVDMD = in vitro dry matter digestibility.

Table 12. Forage production of irrigated summer annual forages grown at PHREC, Scottsbluff, NE, in a regrowth trial, 1992.

Crop	Cultivar	DM Yield (lb/acre)			Dry Matter (percent)		Height (inches)		Stem Diameter (inches)		Maturity (score)
		1st cut	2nd cut	Total	1st cut	2nd cut	1st cut	2nd cut	1st cut	2nd cut	2nd cut
Sudangrass	Sordan 79	3190	2970	6160	17	19	61	22	.44	.27	2
Sorghum x Sudan	Greentreat III	3930	1830	5760	21	20	64	22	.38	.28	2
Sorghum x Sudan	Grazex II	3800	1930	5730	22	23	62	23	.35	.28	2
Sudangrass	SiouxDan HS35	3190	1530	4720	22	17	60	27	.22	.19	2
Sorghum x Sudan	Sweet Sioux V	3530	1140	4670	19	17	62	20	.38	.28	1
Sorghum x Sudan	SSX 587	3130	1230	4360	20	21	59	21	.47	.27	2
Sorghum x Sudan	JX Sue	2640	1710	4350	19	17	61	25	.41	.30	2
Pearl Millet	Millex 24	3790	520	4310	17	22	47	18	.35	.30	3
Pearl Millet	J45	3500	770	4270	18	21	44	15	.35	.25	3
Sudangrass	Trudan 8	2990	1230	4220	20	21	56	30	.25	.27	2
Pearl Millet	HPM	3570	450	4020	17	21	50	21	.47	.25	3
Sorghum	FS5	3060	630	3690	17	18	51	10	.57	.28	3
Pearl Millet	X8999	2460	1210	3670	18	16	56	24	.44	.24	2
Sorghum x Sudan	Sweet Sunny Sioux	2570	950	3520	18	17	62	18	.41	.21	2
Proso Millet	Sunup	1860	30	1890	24	17	36	6	.25	.19	4
Foxtail Millet	Hungarian	1830	30	1860	27	20	34	8	.06	.17	2
Foxtail Millet	Siberian	910	360	1270	26	17	33	14	.06	.15	3
Foxtail Millet	Golden German	710	350	1060	22	18	30	9	.14	.14	3
Foxtail Millet	White Wonder	520	30	550	19	20	33	8	.27	.17	2
	Average	2700	990	3790	20	19	51	17.1	.33	.23	2.4
	LSD 0.05	726	1143	890	.03	.05	4.1	5.5	.12	.08	1.4

Table 13. Production of irrigated summer annual forages at PHREC, Scottsbluff, NE, for a single cutting, 1992.

		DM Yield (lb/acre)	Dry Matter (percent)	Height (inches)	Stem Diameter (inches)	Maturity (score)
Pearl Millet	HPM	7890	36	63	.30	3
Pearl Millet	XF 429	6650	26	58	.36	3
Forage Sorghum	NK300	6540	32	35	.39	3
Forage Sorghum	Sorgo 10	6300	23	52	.43	3
Forage Sorghum	Sorgo 868	6230	25	48	.50	3
Pearl Millet	Millex 24	6200	24	62	.35	3
Pearl Millet	J71A	6060	26	62	.44	3
Pearl Millet	J62	6050	27	38	.36	4
Pearl Millet	KF429	5630	28	53	.33	3
Pearl Millet	J45	5620	28	65	.31	3
Forage Sorghum	FS5	5530	24	56	.53	3
Forage Sorghum	Canex	4980	25	49	.41	2
Forage Sorghum	Sorgo 268	4410	24	48	.41	3
Foxtail Millet	Hungarian	4040	43	30	.13	5
Foxtail Millet	White Wonder	2930	33	45	.25	4
Foxtail Millet	Golden German	2630	36	32	.24	5
Proso Millet	Sunup	2630	38	27	.18	5
Foxtail Millet	Siberian	2300	41	27	.13	5
	Average	5126	31	47	.34	3.5
	LSD 0.05	2765	.08	11.6	.10	0.6

Table 14. Forage quality of irrigated summer annual forages grown at PHREC, Scottsbluff, NE, in a regrowth trial, 1992[a].

Crop	Cultivar	Crude Protein (percent)		Nitrate N (ppm)		IVDMV[b] (percent)		ADF[c] (percent)		NDF[d] (percent)	
		1st cut	2nd cut	1st cut	2nd cut	1st cut	2nd cut	1st cut	2nd cut	1st cut	2nd cut
Sudangrass	Sordan 79	14.5	17.1	4130	2880	59	60	34	31	57	52
Sorghum x Sudan	Greentreat III	14.2	16.9	3140	3110	6	57	33	33	56	54
Sorghum x Sudan	Grazex II	15.1	18.6	3120	2470	60	55	33	33	56	55
Sudangrass	SiouxDan HS35	12.9	18.6	2870	2520	59	58	34	33	58	55
Sorghum x Sudan	Sweet Sioux V	14.1	19.5	2540	2140	62	60	33	32	56	53
Sorghum x Sudan	SSX 587	14.3	19.0	2950	1950	62	59	32	31	55	53
Sorghum x Sudan	JX Sue	14.6	19.6	4040	2600	60	61	33	31	56	53
Pearl Millet	Millex 24	17.3	20.2	7070	2760	60	58	36	31	58	49
Pearl Millet	J45	18.5	19.6	6670	2890	62	59	33	30	54	48
Sudangrass	Trudan 8	14.4	18.6	3160	2800	59	54	34	34	56	56
Pearl Millet	HPM	18.0	20.2	5410	2560	62	57	33	30	55	48
Sorghum	FS5	14.3	19.8	3270	1880	60	58	35	32	59	53
Pearl Millet	X8999	16.0	20.2	3600	2640	60	61	32	31	54	52
Sorghum x Sudan	Sweet Sunny Sioux	15.3	20.8	3010	1970	61	61	33	30	56	51
Proso Millet	Sunup	16.2	—	2350	—	62	—	28	—	49	—
Foxtail Millet	Hungarian	16.9	—	2080	—	60	—	30	—	51	—
Foxtail Millet	Siberian	17.2	—	1980	—	61	—	31	—	53	—
Foxtail Millet	Golden German	19.4	—	2170	—	67	—	28	—	47	—
Foxtail Millet	White Wonder	18.8	—	2890	—	64	—	29	—	49	—
	Average	15.9	19.2	3500	2510	61	68	32	32	54	52
	LSD 0.05	1.6	2.2	1200	820	3.0	5.0	2.4	1.8	3.1	2.2

[a]Blank spaces indicate that little or no regrowth occurred
[b]IVDMD = in vitro dry matter digestibility
[c]ADF = acid detergent fiber
[d]NDF = neutral detergent fiber

Table 15. Forage quality of irrigated summer annual forages grown at PHREC, Scottsbluff, NE, for a single cutting, 1992.

Crop	Cultivar	Crude Protein (percent)	Nitrate N (ppm)	IVDMD[a] (percent)	ADF[b] (percent)	NDF[c] (percent)
Pearl Millet	HPM	12.6	1940	56	34	55
Pearl Millet	XF429	11.0	900	59	31	52
Forage Sorghum	NK300	11.9	330	59	28	49
Forage Sorghum	Sorgo 10	11.5	1050	65	28	49
Forage Sorghum	Sorgo 868	11.6	670	59	31	55
Pearl Millet	Millex 24	13.8	3450	58	33	54
Pearl Millet	J71A	10.2	930	63	30	52
Pearl Millet	J62	11.9	240	60	28	49
Pearl Millet	KF429	11.8	730	57	32	53
Pearl Millet	J45	13.5	3840	53	37	57
Foxtail Millet	Hungarian	12.5	1100	52	34	47
Forage Sorghum	FS5	11.3	730	57	33	56
Forage Sorghum	Sorgo 268	13.1	490	57	31	55
Forage Sorghum	Canex	11.4	960	63	29	50
Foxtail Millet	White Wonder	11.4	1730	52	36	52
Foxtail Millet	Golden German	11.8	1890	54	35	48
Foxtail Millet	Siberian	13.0	1520	51	35	46
Proso Millet	Sunup	12.6	1940	54	33	44
	Average	12.0	1360	57	32	51
	LSD 0.05	2.1	820	4	3	5

[a]IVDMD = in vitro dry matter digestibility
[b]ADF = acid detergent fiber
[c]NDF = neural detergent fiber

Table 16. Production and quality of dryland foxtail millet grown at HPAL, Sidney, NE, 1997.

Cultivar	Yield DM lb per acre	Analyses, DM Basis										
		DM %	CP[a]	ADF[b]	NDF[c]	TDN[d]	NEl[e]	NEm[f]	NEg[g]	RFV[h]	Ca	P
Manta	2897	38	14.4	39.7	62.8	58.1	.59	.57	.31	85.9	.48	.32
Manta 99	2857	38	14	39.7	62.6	58.1	.59	.57	.31	86.2	.46	.32
White Wonder	4139	29	12.9	37.0	60.3	61.2	.63	.61	.35	92.9	.50	.32
Golden German	3169	34	13.4	39.2	61.5	58.6	.60	.57	.31	88.2	.54	.31

Table 17. Production and quality of irrigated hybrid pearl millet grown at PHREC, Scottsbluff, NE, 1997.

Cultivar	Yield DM tons per acre	Analyses, DM Basis										
		DM %	CP[a]	ADF[b]	NDF[c]	TDN[d]	NEl[e]	NEm[f]	NEg[g]	RFV[h]	Ca	P
Mega Mil	7 to 8	17	11.1	42.8	66.0	54.6	.55	.51	.26	78.3	.34	.31

[a]CP = crude protein
[b]ADF = acid detergent fiber
[c]NDF = neutral detergent fiber
[d]TDN = total digestible nutrients
[e]NEl = net energy for lactation
[f]NEm = net energy for maintenance
[g]NEg = net energy for gain
[h]RFV = relative feed value

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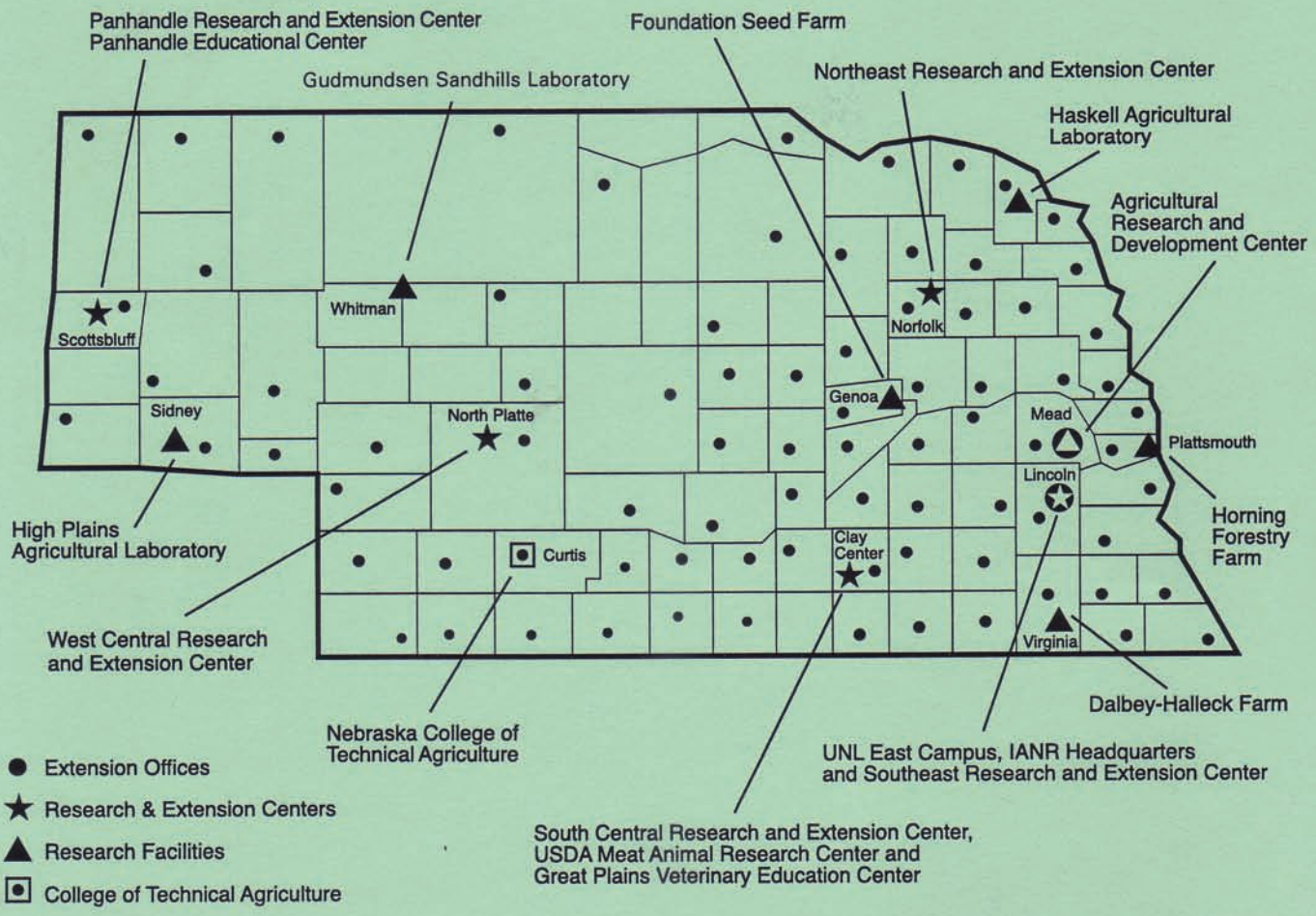
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