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Annual Forage Production and Quality Trials

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Forage crude protein, digestibility and available energy in small grain and sorghum forages will vary with variety and maturity at harvest. Sorghum hybrids containing the brown midrib trait have higher digestibility.

Summary

Two-year forage trials showed higher dry matter yields for winter triticale than for winter wheat while forage qualities were similar. Likewise, a spring triticale cultivar had higher dry matter yields than spring barley or oat cultivars when harvested for forage after heading, and forage qualities were similar. In summer trials, dryland forage sorghum and sorghum x sudangrass hybrids had higher crude protein, digestibility and energy values than irrigated forages because they were not as mature. Lower lignin content and higher digestibility resulted when the brown midrib trait was present in forage sorghum or sorghum x sudangrass hybrids.

Introduction

Data are limited on the forage production and quality potential for currently available annual forages. Changes in production potential and feed quality have occurred, such as lower lignin content and higher digestibility associated with the brown midrib (BMR) trait that has been crossed into some forage sorghum, sudangrass, sorghum x sudangrass and corn hybrids. Forage trials were conducted over two years to compare some of the newer forage cultivars with some that have been around long enough to be considered standards. Forage production and quality were evaluated for cereal forages grown under dryland management and for sorghum, sorghum x sudangrass, and pearl millet forages grown under dryland or irrigated management systems.

Procedure

Dryland winter wheat and triticale cultivars were harvested for forage at Mead, McCook, and Sidney in 1997 and 1998 after producing a seed head. Ten wheat cultivars were planted, including Arapahoe, Lamar, Longhorn, Pronghorn and six experimental cultivars. Five triticale cultivars were planted, including Trical, Newcale, and three experimental cultivars. There were four replications of each cultivar at each location.

Dryland spring seeded cereal crops were harvested as forage at Sidney in 1998 and 1999 after most of the cultivars had produced a seed head. There were two triticale, two barley, and three oat cultivars with four replications of each cultivar. All annual forages were planted in six row plots with a double disc grain drill with 12 in between rows. All forage plots were harvested with a plot swather that cut the center four rows. Mechanical chopping of the forages allowed subsampling for dry matter and forage quality analyses. Quality results were available from 1998 trials only at the time this paper was prepared.

Summer dryland forages were planted at Sidney and included one sudangrass, six sorghum x sudangrass, and eight forage sorghum cultivars. Forages were harvested after the majority of cultivars had headed in growing seasons of 78 and 75 days in 1998 and 1999, respectively. The plots were fertilized with 60 lb of N and 40 lb of P_2O_5 in 1998 and 45 lb of N in 1999.

Summer irrigated forages planted at Scottsbluff included one sudangrass, five sorghum x sudangrass, nine forage sorghum, and three pearl millet cultivars. The plots were harvested after the majority of cultivars had produced a seed head in growing seasons of 82 and 88 days in 1998 and 1999, respectively. They were fertilized with 120 of N and 80 lb of P_2O_5 as a side dress in both years.

Forage quality tests included percentages of dry matter for total and nitrate nitrogen, neutral detergent fiber, acid detergent fiber, acid detergent lignin and in vitro dry matter digestibility (IVDMD). The acid detergent fiber (ADF) values were used to calculate energy values as TDN, net energy and metabolizable energy by using equations listed by the National Forage Testing Association. Least significant differences at the 5% probability level of incorrectly stating a difference were determined for each trait by using the general linear model in the Statistical Analysis Services computer program.

Results

Fall and spring seeded cereal forage results are shown in Table 1. Averages are shown for the 10 winter wheat and 5 triticale cultivars harvested at each location in 1997 and 1998. Although differences in dry matter forage yields were not large, the top yielding winter wheat cultivar at all three locations was Pronghorn, and the top yielding winter triticale cultivar at McCook and Sidney was Newcale. Both of these cultivars were developed by plant breeders in the University of Nebraska system. Forage crude protein (CP) and ADF levels were similar among the wheat and triticale culti-

Table 1. Production and quality of dryland small grain forages in University of Nebraska trials in 1997, 1998, 1999[a].

Winter Forages, 1997-98[b]		DMYLD	CP	NDF	ADF	IVDMD	TDN	NE_m	NE_g	ME
Crop	Location	lb/acre	%	%	%	%	%	Mcal/lb	Mcal/lb	Mcal/lb
Wheat	Mead	6000	8.5	61	29	68	67	.70	.43	1.10
Wheat	McCook	8000	8.8	63	32	70	66	.69	.42	1.09
Wheat	Sidney	5200	9.7	64	35	67	66	.68	.41	1.07
Wheat	Mean	6400	9.0	63	32	68	66	.69	.42	1.09
Triticale	Mead	6800	7.6	65	33	65	66	.68	.41	1.08
Triticale	McCook	9400	8.6	67	36	66	65	.67	.40	1.07
Triticale	Sidney	6400	10.1	68	37	64	65	.67	.40	1.06
	Mean	7500	8.8	67	35	65	65	.67	.40	1.07
Spring Forages, 1998-99[c]										
Crop	Cultivar									
Triticale	2700	4900	8.2	67	37	66	65	.67	.40	1.06
Barley	Horsford	4310	8.8	66	33	70	66	.68	.42	1.09
Barley	Westford	4090	7.9	63	32	66	66	.69	.42	1.09
Oat	Monida	3760	8.9	68	35	70	65	.67	.41	1.07
Oat	Russell	3580	8.4	68	36	66	65	.67	.40	1.07
Oat/Pea	Russell/Pea	3320	9.6	67	36	69	65	.67	.40	1.07
Triticale	Grace	3310	9.2	66	36	68	65	.67	.40	1.07
Oat	Magnum	3120	8.7	67	35	73	65	.68	.41	1.07
	Mean	3800	8.7	67	35	69	65	.68	.41	1.07
	LSD .05	350	1.0	1.3	.9	3.0	.3	.01	.01	.01

[a]Abbreviations are: DMYLD = dry matter yield, CP = crude protein, NDF = neutral detergent fiber, ADF = acid detergent fiber, IVDMD = in vitro dry matter digestibility, TDN = total digestible nutrients, NE_m = net energy for maintenance, NE_g = net energy for gain, ME = metabolizable energy, LSD = least significant difference.
[b]There were 10 wheat and 5 triticale cultivars grown at each location each year in the winter forages.
[c]Dry matter yields are averages for two years, but quality is from 1998 only in the spring forages.

Table 2. Production and quality of dryland summer forages at the University of Nebraska High Plains Ag Lab, Sidney, NE, 1998-99[a].

Crop[b]	Cultivar	DMYLD[c] lb/acre	CP %	NO_3N ppm	NDF %	ADF %	ADL %	IVDMD %	TDN %	NE_m Mcal/lb	NE_g Mcal/lb	ME Mcal/lb
SXS	SX8	6780	11.8	1450	58	30	2.8	76	67	.70	.43	1.10
FS	X24442	6210	11.2	1300	56	28	2.5	79	68	.71	.44	1.11
FS	Sweet N Red	6120	11.3	1450	55	27	2.2	81	68	.71	.44	1.11
SXS	Att-A-Graze	5890	10.6	1100	58	30	3.4	71	67	.70	.43	1.10
FS	XBMR	5700	11.9	1400	54	26	2.2	82	68	.71	.44	1.12
SXS	Sooner Sweet	5680	11.7	1300	58	29	3.3	74	67	.70	.43	1.10
SXS	SXS 94X63	5660	10.4	1100	58	30	3.5	73	67	.70	.43	1.10
SXS	Nutri + BMR	5640	11.9	1500	54	26	2.6	77	68	.71	.44	1.12
FS	BMRX1	5550	12.7	1700	53	25	2.0	82	68	.72	.45	1.12
FS	Canex BMR208	5330	12.2	1450	55	26	2.0	82	68	.71	.44	1.12
FS	X43024	5210	13.0	1750	57	28	2.9	80	68	.71	.44	1.11
SXS	Super Sweet ST	5050	12.0	1200	58	29	3.4	73	67	.70	.43	1.10
FS	Rox Orange	4770	11.5	1550	54	26	2.2	82	68	.72	.44	1.12
S	Piper	4530	9.4	900	62	33	4.1	67	66	.68	.42	1.08
FS	Early Sumac	4300	11.3	1350	55	27	2.2	81	68	.71	.44	1.11
	Mean	5490	11.5	1650	56	28	2.8	77	68	.71	.44	1.11
	LSD .05	790	1.0	200	1.9	1.3	.4	2.3	.4	.01	.01	.01

[a]Abbreviations are: CP = crude protein, NO_3N = nitrate nitrogen, NDF = neutral detergent fiber, ADF = acid detergent fiber, ADL = acid detergent lignin, IVDMD = in vitro dry matter digestibility, TDN = total digestible nutrients, NE_m = net energy for maintenance, NE_g = net energy for gain, ME = metabolizable energy, LSD = least significant difference.
[b]Crop abbreviations are as follows: SXS = sorghum x sudangrass, FS = forage sorghum, S = sudangrass.
[c]Dry matter yields are averages for two years, but quality is from 1998 only.

vars at each location, making energy levels calculated from ADF similar also.

The top yielding spring cereal forage was triticale cultivar 2700. The barley cultivars ranked second and third in dry matter yields. Forage CP levels were similar with an average of 8.7% of dry matter. Energy levels were also similar with an average of 65% TDN, which was the same as in the winter forages.

Dry matter yields for dryland summer forages in Table 2 are an average of trials in 1998 and 1999. Dry matter percentages, plant heights and maturity scores are not shown, but were similar between years. Crude protein levels for 1998 ranged from 13 to 9.4% of dry matter, which was consistent with the maturity stages that ranged from boot to headed. Producers who want summer forage high in crude protein and digestibility should harvest crops more than once a season when the crops have regrowth capability. Other producers may want more dry matter yield with a single cut system when the crude protein

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Table 3. Production and quality of irrigated summer annual forages at the UNL Panhandle Res. & Ext. Center, Scottsbluff, NE, 1998[a].

Crop[b]	Cultivar	DMYLD[c] lb/acre	CP %	NO_3N ppm	NDF %	ADF %	ADL %	IVDMD %	TDN %	NE_m Mcal/lb	NE_g Mcal/lb	ME Mcal/lb
SXS	Super Sweet ST	13600	8.5	500	61	35	5.7	65	65	.67	.41	1.07
FS	XBMR	13520	8.7	800	58	32	2.5	77	66	.69	.42	1.09
FS	Sweet N Red	13230	9.7	1000	61	34	4.2	69	66	.68	.41	1.08
SXS	Att-A-Graze	13120	8.9	650	61	36	6.5	62	65	.67	.40	1.07
FS	X24442	13040	9.8	800	62	36	4.6	67	65	.67	.40	1.07
SXS	Sooner Sweet	12980	9.0	700	62	36	5.7	65	65	.67	.40	1.07
FS	Canex BM208	12900	8.7	800	53	29	3.7	77	67	.70	.43	1.10
FS	X43024	12760	10.8	1050	63	36	4.0	70	65	.67	.40	1.07
SXS	Nutri + BMR	12100	7.9	700	61	35	5.3	64	65	.67	.41	1.07
SXS	SXS 94X63	12010	8.0	500	61	36	5.6	64	65	.67	.40	1.07
FS	Early Sumac	11930	9.5	750	61	35	4.4	68	65	.67	.41	1.07
FS	FS22	11920	11.1	1100	64	36	4.2	67	65	.67	.40	1.07
PM	Mega Mil	11300	11.8	2000	66	39	4.7	68	64	.66	.39	1.06
FS	Rox Orange	11220	9.2	900	61	35	4.1	70	65	.67	.41	1.07
S	Piper	10910	8.2	500	66	39	5.9	60	64	.66	.39	1.05
PM	P10XIM	10800	10.5	1250	66	38	5.7	61	64	.66	.39	1.06
FS	BMRX1	10780	9.9	1000	60	34	4.0	68	66	.68	.41	1.08
PM	HPM	9990	12.0	2100	65	37	5.3	63	65	.66	.40	1.06
	Mean	12120	9.6	950	62	35	4.8	67	65	.67	.41	1.07
	LSD .05	1240	1.6	650	3.6	2.8	1.0	4.2	2.9	.01	.01	.02

[a]Abbreviations are: DMYLD = dry matter yield, CP = crude protein, NO_3N = nitrate nitrogen, NDF = neutral detergent fiber, ADF = acid detergent fiber, ADL = acid detergent lignin, IVDMD = in vitro dry matter digestibility, TDN = total digestible nutrients, NE_m = net energy for maintenance, NE_g = net energy for gain, ME = metabolizable energy, LSD = least significant difference.
[b]Crop abbreviations are as follows: SXS = sorghum x sudangrass, FS = forage sorghum, S = sudangrass, PM = pearl millet.
[c]Dry matter yields are averages for two years, but quality is from 1998 only.

and TDN contents are adequate for the animals that will consume the forage.

Dry matter yields for irrigated summer forages are shown in Table 3 as an average of 1998 and 1999 trials. In Tables 2 and 3, cultivars with an X before or after numbers or a name were experimental cultivars in the years of these trials. High yielding cultivars included both forage sorghum and sorghum x sudangrass hybrids. Some brown midrib hybrids had good yields but showed some lodging in the single harvest system that allowed them to grow 6 to 7 ft tall, but this was also true for some non-BMR hybrids.

Forage quality results shown for 1998 indicate variation in CP and IVDMD, which often is due to maturity differences when harvested. However, the emergence of summer forages with increased digestibility, such as the brown midrib cultivars in forage sorghum, sorghum x sudangrass, pearl millet and corn hybrids, brings new opportunities for improved animal performance through grazing or feeding of these forages. Reduced lignin fiber content of these forages allows for greater digestibility, but multiple harvest or grazing systems may be needed to minimize lodging problems that can occur if they get too tall. In both the irrigated and dryland trials in 1998, the highest IVDMD values were associated with the lowest acid detergent lignin percentages which are typical for many BMR hybrids.

Nitrate nitrogen levels in Tables 2 and 3 were generally below the 2000 ppm level often listed for initial toxicity concern for ruminants. However, previous research with similar forages in western Nebraska showed some potentially toxic nitrate levels in irrigated forage in the first of two harvests during the summer, especially with high nitrogen fertility in the soil. Thus, nitrogen application rates will need to be managed carefully along with maturity stage at harvest to achieve satisfactory levels of CP without increasing nitrates to toxic levels.

The choice of an annual forage crop and cultivar may depend more on the time forage is needed in the grazing or harvested forage system rather than on differences in yield potential. Fitting a forage crop into a cropping system would be an important consideration. Also, equipment requirements for the shorter annuals, like small grain or foxtail millet forages, may already be in an operation for other hay crops, whereas equipment needed to easily harvest and feed the taller forages may be unique. Getting the thicker stemmed forages to dry down in a reasonable time period for making hay will usually require a crimping action of the forage during cutting. The emergence of hybrids with higher digestibility may enhance grazing of standing or windrowed summer annual forages during the winter.

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