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Agronomic and silage quality traits of forage sorghum cultivars in 1995 (1997)

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AGRONOMIC AND SILAGE QUALITY TRAITS OF FORAGE SORGHUM CULTIVARS IN 1995

M. K. Siefers, J. E. Turner, G. L. Huck, M. A. Young, S. A. Anderson, R. V. Pope, and K. K. Bolsen

Summary

Agronomic and silage quality traits were measured for 37 forage sorghum cultivars and three grain sorghum hybrids. The 1995 growing season was characterized by above average rainfall in the spring and early summer, and a hard freeze on September 22. At the time of the freeze, 20 cultivars had reached the early-milk to early-dough stage, 12 were in the bloom stage, and the remaining eight were still in the early- to late-boot stage. The late planting date and low plant populations resulted in below-normal whole-plant DM and grain yields. Plant heights for the grain sorghums were near normal, but the forage sorghums were well below expected plant heights. The preensiled, whole-plant DM contents of the 37 forage sorghums ranged from 23.0 to 39.9%. As expected, the silage nutritive value traits of CP, NDF, and ADF were most favorable for the three grain sorghum hybrids and least favorable for the eight forage sorghum hybrids that were still in the boot stage when the freeze occurred.

(Key Words: Sorghum, Grain, Forage, Silage, Quality Traits.)

Introduction

Forage sorghum is an important silage crop for beef and dairy cattle producers in the High Plains region of the United States. Sorghums have greater drought tolerance, better ability to recover from drought, and lower production costs than corn. Kansas livestock producers harvested about 80,000 acres of sorghum for silage in 1995, which yielded approximately 800,000 tons.

Results from earlier studies indicated that cultivar and growing season have a tremendous effect on agronomic and silage quality traits of forage sorghums (KAES Report of Progress 678, page 13; and KAES Report of Progress 727, page 68). Our objective was to continue documenting agronomic performance and silage quality traits over a wide range of forage sorghum cultivars currently available in Kansas.

Experimental Procedures

Thirty seven forage sorghum cultivars and three grain sorghum hybrids were selected to represent a wide range of phenotypic characteristics and season lengths. All were grown under dryland conditions in 1995 near the Kansas State University campus. The forage and grain sorghum plots were planted on July 3, and each cultivar was assigned randomly to each of three replications. The six-row plots were in a Reading silt loam soil with anhydrous ammonia applied at 80 lb of nitrogen per acre. Rows were 27 ft long with a 30-inch spacing, and plots were thinned to a uniform stand of 26,000 to 28,000 plants per acre.

The three grain sorghums and 11 of the 17 forage sorghums that had reached the early-milk to early-dough stage before a hard freeze on September 22 were harvested between September 26 and October 6. The remaining 26 forage sorghums were harvested on October 19, which is near the average annual first-freeze date for the Riley County location of the plots.

The two outside rows in each plot were protective borders. All heads in two inside rows were hand clipped, and the heads were dried in a forced air oven for 2 weeks. The dried heads were threshed with a stationary machine, and the grain yield was adjusted to a 14.5% moisture basis. Whole-plant DM yield was measured by harvesting the two remaining

inside rows with a FieldQueen precision forage harvester. The chopped material from each plot was sampled for whole-plant DM determination and ensiled in 4 × 14-inch PVC laboratory-scale silos. All silos were packed to similar densities using a specially designed hydraulic press. The PVC silos were opened after approximately 90 days of storage. All silages were analyzed for pH and DM, crude protein (CP), neutral detergent fiber (NDF), acid detergent fiber (ADF), and ash contents.

Results and Discussion

Agronomic performance of the 40 sorghum cultivars is shown in Tables 1 and 2. Days to half bloom for the 16 grain-producing forage sorghum cultivars that reached the early-milk to early-dough stage before September 22 ranged from 56 to 67 days. Plant heights for all 37 forage sorghums were below normal. As expected, the three grain sorghums were the shortest overall. Two of the late-season hybrids (Mycogen Red Top Kandy and Casterline Supersile) were the tallest forage sorghums; Pioneer 841F, DeKalb X585, and Golden Harvest H-45 were the shortest.

The preensiled whole-plant DM contents of the 37 forage sorghums ranged from 23.0 to 39.9%. The three grain sorghum hybrids averaged 37.5% DM, whereas the eight late-season forage sorghum hybrids that were harvested in the boot stage averaged only 24.1% DM. The average pH of 3.9 indicated an extensive fermentation phase, which was primarily a function of the low DM content of most cultivars. Forages ensiled with less than 30% DM can produce large amounts of effluent during initial storage. Whole-plant DM yield was highest for two late-season hybrids (Century II Hygrachop and Casterline Supersile) and the middle-season DeKalb FS-5, whereas Pioneer 8771 grain sorghum and Early Sumac forage sorghum had the lowest whole-plant DM yields. Grain yields were below normal for the three grain sorghums and the 16 forage sorghums that produced grain. Pioneer 8771 grain sorghum and DeKalb X489 forage sorghum had the highest grain yields, and Early Sumac variety had the lowest grain yield. Surprisingly, none of the 40 sorghum cultivars lodged before harvest.

Silage quality traits of the 40 sorghums are shown in Tables 1 and 3. As expected, the three grain sorghum silages had a higher average CP content (10.4%) and lower average contents of NDF (46.8%) and ADF (27.9%) than the 37 forage sorghum silages. Among the forage sorghums, CP values ranged from 7.2% (Mycogen Red Top Kandy) to 10.1% (Northrup King 300). The NDF values ranged from 45.1% (NC+ Nutri-Cane II) to 58.0% (Cargill 455). The ADF values ranged from 27.3% (NC+Nutri-Cane II) to 36.5% (Pioneer 923).

The early freeze on September 22 coupled with the late planting date and low plant populations resulted in below-normal whole-plant DM and grain yields for all 40 cultivars. The silages of the 16 grain producing forage sorghums that reached the early-milk to early-dough stage before the freeze had an average DM content of 28.3%, whereas the silages of the 20 forage sorghums with little or no grain fill had an average DM content of 23.1%. In addition to a suitable DM content, the early- and middle-season cultivars that produced grain also had higher silage quality traits than the 20 late-season cultivars, as evidenced by a higher average CP content (8.6% vs. 8.3%) and lower average contents of NDF (48.9% vs. 54.4%) and ADF (29.6% vs. 33.8%).

These data indicate that in the 1995 growing season, the late-season forage sorghum cultivars generally produced more whole-plant DM yield than the grain sorghums or early- and middle-season forage sorghums. However, the late-season cultivars had the lowest nutritive values and would be prone to produce excessive effluent and undergo an unfavorable fermentation because of their low DM content.

Table 1. Mean Agronomic Performance and Silage Quality Traits of the Grain Sorghums, Forage Sorghums that Produced Grain (w/grain), and Forage Sorghums that Did Not Produce Grain (w/o grain)

Cultivar [1]	Plant Ht.	Whole-Plant DM Content	Whole-Plant DM Yield	Grain Yield	Whole-Plant Silage					pH
					DM	CP	NDF	ADF	Ash	
	inches	%	tons/acre	bu/acre		%	- % of the silage DM -			
Grain sorghum (3)	43.8	37.5	3.5	52.4	3.9	36.0	10.4	46.8	27.9	7.7
Forage sorghum (w/grain) (17) [2]	73.4	30.8	4.4	44.4	3.8	28.0	8.6	48.9	29.6	6.6
Forage sorghum (w/o grain) (20)	81.4	25.0	4.8	0	3.8	23.1	8.3	54.4	33.8	7.1

[1]Number of cultivars is shown in parenthesis.
[2]Mycogen Greenleaf Sterile was not included in the calculation of the mean grain yield.

Table 2. Agronomic Performance of the 40 Sorghum Cultivars

Cultivar[1]	Days to 1/2 Bloom[2]	Harvest Date	Plant Ht.	Whole-Plant DM Content	Whole-Plant DM Yield	Grain Yield[3]
Grain sorghum			inches	%	tons/acre	bu/acre
Pioneer 8771	52	Sept. 26	39	40.2	3.1	59
Pioneer 8500	56	Oct. 3	46	38.2	3.5	55
Pioneer 8310	57	3	46	34.0	3.8	43
Forage sorghum						
Buffalo Canex	56	Oct. 3	79	30.7	3.6	30
Mycogen Greenleaf AP	57	3	67	36.5	4.5	56
NC+ Nutri-Choice	58	3	65	39.9	4.8	57
DeKalb FS-5	59	6	83	35.0	5.5	53
Casterline Sucane	59	3	80	28.5	4.0	37
Cargill 200F	59	3	73	37.2	4.2	49
Rox Orange	59	3	70	23.5	3.2	30
NC + 305F	60	6	83	27.5	4.5	44
Early Sumac	60	3	75	24.5	3.0	18
DeKalb FS-2	60	6	66	31.7	5.2	49
Mycogen Greenleaf Sterile	---	6	84	27.1	4.4	---
DeKalb X585	61	19	60	29.7	4.2	51
Pioneer 849F	62	19	82	32.2	5.1	52
NC+ Nutri-Cane II	62	19	76	30.5	4.7	43
Pioneer 841F	62	19	60	30.5	4.6	49
DeKalb X489	63	19	66	27.4	5.1	58
Atlas	67	19	80	28.4	3.5	33
NK 300	33% bl	19	61	25.8	4.2	---
NC + 965	25% bl	19	101	24.7	4.8	---
Mycogen Greenleaf	25% bl	19	73	26.8	4.3	---
Mycogen Milk-A-Lot	25% bl	19	62	30.9	5.4	---
Century II Hygrachop	20% bl	19	104	25.3	5.6	---
Golden Harvest H-45	20% bl	19	58	26.4	4.7	---
NK XF429	15% bl	19	103	25.1	5.4	---
Pioneer XSF-35	15% bl	19	73	26.4	5.1	---
Golden Harvest H-46	40% hd	19	71	26.7	4.6	---
Mycogen Silomaker	30% hd	19	71	25.5	4.9	---
Pioneer XSF-36	20% hd	19	71	23.7	5.2	---
Pioneer 838F	20% hd	19	65	24.5	4.1	---
Mycogen Red Top Kandy	Late-bt	19	112	23.0	4.9	---
Casterline Supersile	Late-bt	19	108	23.7	5.5	---
ICI 333	Late-bt	19	78	25.3	4.2	---
Pioneer 923	Early-bt	19	99	25.7	4.9	---
Pioneer XSF-45	Early-bt	19	94	23.4	5.3	---
DeKalb FS-25E	Early-bt	19	87	22.9	4.9	---
NK X920	Early-bt	19	73	23.7	5.0	---
Cargill 455	Early-bt	19	62	25.0	4.2	---
LSD (P < .05)[4]			4.7	2.9	.7	---

[1]NK is Northrup King, and an X in a hybrid's number indicates that it is experimental.
[2]bl = bloom stage, hd = heading stage, and bt = boot stage.
[3]Adjusted to a 14.5% moisture basis.
[4]The LSD (least significant difference) is valid only within a column.

Table 3. Silage Quality Traits of the 40 Sorghum Cultivars

	Whole-Plant Silage					
Cultivar	pH	DM	CP	NDF	ADF	Ash
Grain sorghum		%	% of the silage DM			
Pioneer 8771	4.0	40.8	10.8	42.5	26.0	7.0
Pioneer 8500	3.9	36.6	10.3	48.6	28.5	8.0
Pioneer 8310	3.8	30.6	10.1	49.4	29.3	8.0
Forage sorghum						
Buffalo Canex	3.7	28.8	8.0	47.3	28.4	7.2
Mycogen Greenleaf AP	3.9	34.1	9.2	47.7	28.3	6.6
NC + Nutri-Choice	3.9	34.0	9.6	51.4	30.0	7.4
DeKalb FS-5	3.8	29.5	8.2	49.5	30.2	6.5
Casterline Sucane	3.8	25.1	7.7	52.3	29.3	6.2
Cargill 200F	3.9	35.0	9.2	49.2	29.7	6.8
Rox Orange	3.7	23.3	8.1	51.1	30.7	6.5
NC + 305F	3.7	25.2	8.0	48.0	29.4	6.5
Early Sumac	3.7	20.7	8.1	51.8	31.6	7.1
DeKalb FS-2	3.8	27.8	9.4	47.0	28.2	7.9
Mycogen Greenleaf Sterile	3.6	24.1	8.5	49.5	31.0	6.5
DeKalb X585	3.9	28.3	9.5	45.9	28.9	5.8
Pioneer 849F	3.8	30.2	8.3	48.0	28.9	6.4
NC + Nutri-Cane II	3.8	28.5	7.9	45.1	27.3	5.6
Pioneer 841F	3.8	28.1	9.4	50.4	31.3	6.9
DeKalb X489	3.8	27.2	9.0	46.2	28.3	6.5
Atlas	3.8	26.6	8.1	50.9	31.9	5.8
NK 300	3.9	27.0	10.1	56.5	34.0	8.6
NC + 965	3.8	22.6	7.6	51.8	32.1	7.0
Mycogen Greenleaf	3.9	24.5	9.0	53.1	33.2	7.3
Mycogen Milk-A-Lot	3.9	25.5	9.4	56.0	34.4	7.0
Century II Hygrachop	3.9	22.8	7.4	52.9	32.6	6.7
Golden Harvest H-45	3.9	23.2	8.9	55.2	33.5	7.0
NK XF429	3.8	23.0	7.3	52.3	33.3	6.2
Pioneer XSF-35	3.9	24.1	8.7	54.4	32.7	7.0
Golden Harvest H-46	3.9	24.2	9.4	53.0	32.2	7.6
Mycogen Silomaker	3.9	22.7	8.1	54.6	33.6	7.2
Pioneer XSF-36	3.8	23.1	8.3	56.3	34.9	7.4
Pioneer 838F	3.9	22.3	9.4	54.4	33.9	8.1
Mycogen Red Top Kandy	3.8	19.9	7.2	50.9	33.1	5.9
Casterline Supersile	3.8	21.7	7.4	53.7	33.7	6.1
ICI 333	3.9	23.0	8.0	55.2	34.0	6.6
Pioneer 923	3.9	24.2	8.1	57.0	36.5	7.0
Pioneer XSF-45	3.9	20.9	7.7	54.4	34.6	6.8
DeKalb FS-25E	3.8	21.1	8.1	53.3	33.2	6.7
NK X920	3.9	22.4	8.0	54.8	34.7	8.2
Cargill 455	3.9	23.8	8.8	58.0	36.2	7.7
LSD ($P < .05$) [1]	.1	4.1	1.0	3.8	3.0	1.1

[1]The LSD (least significant difference) is valid only within a column.