Effect of Sorghum Type and Harvest Date on Silage Feeding Value

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Summary

Five silages produced in 1982 were evaluated in two growing trials using 96 steer calves. Forage sorghum silage (heading) was assigned a feeding value of 100. Based on comparative rates and efficiencies of gain, feeding value for the grain sorghum silage averaged 107.5 in Trial 1. The non-heading forage sorghum silage had a value of 64.6 in Trial 1 but only 40.2 before freezing and 31.4 after freezing in Trial 2. The poor values for the non-heading silages were due, in part, to very low feed intakes. There was no advantage in harvesting the non-heading sorghum after a freeze. Rolling the grain sorghum silage to break 95% of the grain did not improve its value. In Trial 2, adding alfalfa haylage to the non-heading silages did increase steer performance.

Introduction

Sorghum's importance as a feed grain and silage crop has increased steadily in the high-plains region during the past 25 years. In 1981 and 1982, more acres and tons of sorghum than corn were harvested, stored, and fed as silage in Kansas. Today, improved forage sorghum hybrids often give dry matter yields comparable to corn but with lower production costs. Because of their high grain content, corn silages are superior to sorghum silages, especially when high-silage rations are fed to growing cattle. Also, variation in feeding value is often large between the sorghum varieties, due to such factors as maturity (early and late season), plant height, grain and forage yields, dry matter content, and plant composition (crude protein, fiber, etc.).

Only limited information is available concerning the feeding values of silages made with improved hybrids from the three major sorghum types: (1) grain-type; (2) grain-producing forage-type; and (3) non-heading forage-type. Documenting these feeding values was one objective of these trials.

Previous research at Hays and Manhattan has shown that processing whole-plant sorghum silages is not cost effective. A second objective was to continue our comparison of processed and unprocessed grain sorghum silages.

Experimental Procedures

Trial 1. Three whole-plant silages were made in the fall of 1982: 1) Dekalb E 67 red grain sorghum (grain sorghum); 2) Pioneer 947 forage sorghum (heading); 3) Funks G 1990 hybrid forage sorghum (non-heading). The harvest dates and dry matter (DM) contents are shown in Table 12.1.

All crops were direct-cut using a Field Queen forage harvester equipped with a 2-inch recutter screen. The non-heading and heading forage sorghums were ensiled in 10 x 50 ft. and the grain sorghum in a 16 x 50 ft. concrete stave silo. The silos were opened on November 18 and 19, 1982.

Each of the three silages was fed without further processing. Grain sorghum silage also was fed after processing with a Roskamp® model K roller mill to break about 95% of the grain. Each silage ration was fed to 16 Angus, Angus x Hereford, Angus x Simmental, and Hereford x Simmental steer calves (four pens of four calves per ration). Each silage was full-fed with 1.8 lb (DM basis) of supplement per steer daily. Rations were formulated to provide 12.5% crude protein (DM basis), 150 mg of monensin per calf daily, and equal amounts of calcium, phosphorus, and vitamin A. The growing trial was 56 days (November 20, 1982 to January 14, 1983).

For 3 weeks before the trial began, all the calves were fed free-choice prairie hay and 3 lb of rolled milo plus soybean meal concentrate. All calves were weighed individually on 2 consecutive days after 16 hr without feed or water, at the start and at the end of the trial. Prior to the final weighings, all calves were fed the same amount of feed (about 10 lb of DM). Intermediate weights were taken before the A.M. feeding on day 28. The calves were implanted with 36 mg of Ralgro at the start of the trial.

Each silage was sampled twice weekly. Feed intake was recorded daily for each of the 16 pens and the quantity of silage fed adjusted daily to assure that fresh feed was always in the bunks. Feed not consumed was removed, weighed, and discarded as necessary.

Trial 2: Three silages were made in the fall of 1982: Cargill 200 forage sorghum (heading) and Funks G 1990 forage sorghum (non-heading), harvested either before or 1 week after freezing. The harvest dates and dry matter contents are shown in Table 12.1.

All crops were harvested as described in Trial 1. The non-heading, pre-freeze sorghum silage was the same silage used in Trial 1. The heading forage sorghum and the post-freeze non-heading sorghum were ensiled in 14 x 60 ft. concrete stave silos. For each silage, six nylon bags were filled with about 30 lb of crop and buried at two different depths.

Six rations were compared: each silage was fed with (50/50 mixture DM basis) and without alfalfa haylage (haylage) from a Harvestore®. The cattle were the same ones used in Trial 1; all received the appropriate forage plus 1.8 lb (DM basis) of supplement daily. All rations contained 12.5% crude protein. Haylage provided about 62, 61, and 64% of the total ration protein for the non-heading pre- and post-freeze and heading silage rations, respectively. Calves were allotted by weight and previous rate of gain to minimize any carry-over influence from Trial 1. Final weights from Trial 1 were used as starting weights for Trial 2 and final weights were taken as described in Trial 1. The growing trial was 54 days (January 14 to March 8, 1983).

Results and Discussion

The five silages fed in the two trials were well preserved and free of visable mold or spoilage. Chemical analyses and dry matter recoveries for silages are shown in Table 12.1. The wet, pre-freeze non-heading silage had the least efficient fermentation and the lowest DM recovery. The drier post-freeze silage had a more desirable lactic acid fermentation and a better DM recovery. The analyses of the heading and grain sorghum silages were typical.

Trial 1: Preformance by calves fed the four silages is shown in Table 12.2. The two grain sorghum silages gave the fastest gains and highest intakes ($P<.05$); non-heading sorghum silage, the slowest gain and lowest intake ($P<.05$). Performance by calves fed heading forage sorghum silage was intermediate, except they made 3.3% more efficient gains than steers fed grain sorghum silage.

Rolling the sorghum silage to crack the grain did not significantly improve its nutritional value. Although cattle feeders often express concern about how effectively the sorghum grain from whole-plant silages is digested, the good performance by calves in this trial and a similar trial in 1981 (Report of Progress 427) suggests that the grain was well utilized. Also, high DM intakes (except for the non-heading silage) and mild weather contributed to fast and efficient gains. Some of the gain may have been compensatory, since the pre-trial hay + grain ration was rather low in energy. But our weighing procedures should have prevented excessive fill from biasing the gains upward.

Trial 2: Performance by calves receiving the six rations is shown in Table 12.3. Heading sorghum silage rations produced faster gains ($P<.05$) and higher intakes ($P<.05$) than any of the non-heading silage rations. Steers fed the post-freeze non-heading silage alone gained significantly slower and were less efficient ($P<.05$), even though they had higher DM intakes ($P<.05$), than steers fed the pre-freeze non-heading silage. Haylage, when added to the pre- and post-freeze non-heading silages, significantly improved steer performance. However, when haylage was added to the heading silage, rate and efficiency of gain were slightly reduced. Cold weather adversely affected performance in this trial.

The growing season was favorable in Manhattan and produced a high grain content in the grain sorghum and heading forage sorghum silages. In Trial 1 grain made up 47.9% of the silage dry matter in the grain sorghum silage and 31.4% in forage sorghum silage.

Relative feeding values for the silages in both trials were compared by assigning a value of 100 to the heading forage sorghum silages. Based on comparative rates and efficiencies of gain, grain sorghum silage had a feeding value of 108 when unprocessed and 107 when processed. The pre-freeze non-heading forage sorghum had a feeding value of 64.6 in Trial 1 and 40.2 in Trial 2. Delaying harvest of the non-heading sorghum until after a freeze reduced its relative feeding value to 31.4. These disastrously low values for the non-heading silages reflect their high moisture content, absence of grain, low digestibility, and poor DM intake.

Table 12.1 Chemical Analyses and Dry Matter Recoveries for the Silages and Haylage in Trials 1 and 2.

Item	Trial 1				Trial 2	
			Non-heading			
	Grain sorghum	heading	pre-freeze*	post-freeze	heading	haylage
Harvest date (1982)	9/20	9/23	10/4	11/1	9/27	5/25
Dry matter:						
pre-ensiled, %	37	31	24	31	34	—
silage, %	36	30	22	30	33	58
	.....% of the DM ensiled.....					
Dry matter recoveries:						
concrete stave silo	90.6[c]	85.6	79.9	—	—	—
buried bag[a]	—	—	89.7	92.8	94.9	—
lab silo[b]	95.5	92.2	—	—	—	—
	.....% of the silage DM.....					
Lactic acid	5.10	4.62	2.77	4.15	4.70	.49
Acetic acid	1.61	.75	6.00	1.59	1.15	.64
Propionic acid	.02	.01	.83	.01	.01	.04
Butyric acid	.01	.01	.09	.03	.06	.01
Total fermentation acids	6.72	5.40	10.3	5.80	5.90	1.27
Crude protein	8.9	8.6	6.5	5.8	8.9	18.1
	.....% of the total N.....					
Hot water insoluble-nitrogen	62	72	36	45	54	45
pH	4.19	3.90	4.10	4.05	4.01	5.31

*This silage was fed in both trials.

[a]Mean of six nylon bags.

[b]Mean of six lab silos.

[c]Estimated recovery.

Table 12.2 Performance by Calves Fed the Four Silage Rations (Trial 1).

Item	Silage			
	non-heading	heading	Grain sorghum unprocessed	Grain sorghum processed
No. of calves	16	16	16	16
Initial wt., lb	452	453	453	452
Final wt., lb	505	552	572	568
Avg. daily gain, lb	.95[c]	1.77[b]	2.12[a]	2.07[a]
Avg. daily feed, lb[1]	8.43[c]	11.88[b]	15.01[a]	14.45[a]
Feed/lb of gain, lb[1]	9.0[b]	6.8[a]	7.1[a]	7.0[a]
Relative feeding value[2]	64.6	100	108	107

[abc]Values with different superscripts differ significantly (P<.05).
[1]100% dry matter basis.
[2]Based on comparative rates and efficiencies of gain, with performance by calves fed heading forage sorghum silage assigned a value of 100.

Table 12.3 Performance by Calves Fed the Six Silage and Haylage Rations (Trial 2).

Item	Non-heading					
	pre-freeze	pre-freeze +haylage	post-freeze	post-freeze +haylage	Heading	Heading +haylage
No. of calves	16	16	16	16	16	16
Initial wt., lb	545	545	549	549	546	547
Final wt., lb	566	577	560	573	616	613
Avg. daily gain, lb	.39[c]	.57[b]	.19[d]	.42[c]	1.26[a]	1.16[a]
Avg. daily feed, lb[1]						
silage	5.86	4.73	8.72	5.23	14.01	7.38
haylage	—	4.91	—	5.18	—	7.34
supplement	1.8	1.8	1.8	1.8	1.8	1.8
total	7.66[c]	11.44[b]	10.52[b]	12.21[b]	15.81[a]	16.52[a]
Feed/lb of gain, lb[1]	25.54[ab]	20.11[ab]	56.26[c]	29.75[b]	12.58[a]	14.23[a]
Relative feeding value[2]	40.2	—	31.4	—	100	—

[abc]Values with different superscripts differ significantly (P<.05).
[1]100% dry matter basis.
[2]See Table 12.2.