# Whole-plant Forage and Grain Sorghum Silages for Growing Cattle

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## Summary

Four trials were conducted to determine the feeding value of whole-plant forage and grain sorghum silages. In general, growing cattle fed grain sorghum hybrids (NK2778, Funk's 550, DeKalb 42Y, DeKalb E67) out performed those fed forage sorghum silages. Only moderate to high grain-content, forage sorghums (Buffalo Canex, Pioneer 947, Acco 351) gave performances that approached the grain sorghums. Low grain-content and nonheading forage sorghums (DeKalb 25E, Funk's G-1990) resulted in the poorest cattle performance. These studies indicate that grain content of a sorghum silage is the major determinant of cattle performance and that whole-plant grain sorghums should produce the fastest and most efficient gains in growing programs.

## Introduction

Whole-plant, grain sorghum silage offers an alternative to traditional forage sorghum silages for feeding growing cattle. Grain sorghum silages generally have the following advantages over their forage sorghum counterparts: 1) higher grain content, which leads to higher daily gains, thus largely offsetting the yield advantages of forage sorghums; 2) more protein, which will lower supplementation costs; and 3) earlier maturity and improved dry-down characteristics, leading to better silage preservation and increased silage intake.

Summarized here are data from 4 years of feeding comparisons between whole-plant, grain sorghum and forage sorghum silages used for growing cattle.

## Experimental Procedures

Summarized in Table 37.1 are the harvest dates, dry matters, and crude protein contents at harvest for the forage and grain sorghum hybrids used in the 1985 trial (Trial 4), as well as hybrids used in the three previous years (Trials 1, 2, and 3).

Further details of procedures for Trials 1, 2, and 3 are in the Reports of Progress 448, 470, and 494, respectively.

All hybrids were direct-cut using a Field Queen forage harvester. Grains were in the late-dough stage, except for the nonheading Funk's G-1990, which was ensiled on the same day as Pioneer 947 in Trial 1 and DeKalb 25E in Trial 2. All silages were made in either 10 x 50 ft or 14 x 60 ft concrete stave silos, except Pioneer 947 and DeKalb 25E in Trial 4, which were ensiled in 8 x 75 ft AgBags®.

Trial 1. The three whole-plant silages were each fed to 16 steer calves (four pens of four calves per ration with an initial avg. wt. of 453 lb). Each silage was full-fed with 2.0 lb of supplement per calf daily (as-fed basis). Rations were formulated to provide 12.5% crude protein (CP) on a dry matter (DM) basis, 150 mg of Rumensin® per head daily, equal amounts of calcium and phosphorus, and vitamin A. All calves received hormonal implants at the start of the trial. The growing trial lasted 56 days; November 20, 1982 to January 14, 1983.

Trial 2. The three whole-plant silages were each fed to 20 crossbred steers (four pens of five steers per ration with an initial avg. wt. of 572 lb). Rations were formulated and fed as described in Trial 1, except they contained 12.0% CP (DM basis) and provided 200 mg of Rumensin. The growing trial lasted 84 days; December 15, 1983 to March 9, 1984.

Trial 3. The three whole-plant silages were each fed to 16 crossbred steers and heifers (two pens of four steers and two pens of four heifers per ration) with an initial avg. wt. of 623 and 553 lb, respectively. Rations were formulated and fed as described in Trial 2, except the steer rations contained 11.0% CP (DM basis). The growing trial lasted 84 days; February 15 to May 10, 1985.

Trial 4. In 1985, whole-plant silages were made from four forage sorghum and three grain sorghum hybrids. Each silage was fed to eight crossbred steer and heifer calves (two pens of three steers and one heifer per ration with an initial avg. wt. of 538 lb). The fixed-percentage rations contained 87.6% silage and 12.4% supplement (DM basis). Each ration provided 12.0% CP (DM basis), 200 mg of Rumensin per calf daily, equal amounts of calcium and phosphorus, and vitamin A. The growing trial lasted 70 days; December 6, 1985 to February 14, 1986.

Calves were weighed on 2 consecutive days at the beginning and end of the trial, after 16 hr without feed or water. To minimize fill effects, all calves were fed a forage sorghum silage ration at 1.75% of body weight (DM basis) for 1 week before the trial began.

Samples of each silage were taken twice weekly. Feed intake was recorded daily for each pen and the quantity of complete-mixed ration was adjusted daily to assure that fresh feed was always in the bunks. Feed not consumed was removed, weighed, and discarded as necessary.

## Results and Discussion

Chemical analyses of the silages fed in Trials 1, 2 and 3 are shown in Table 37.2. Dry matter and CP values were largest, and fiber components smallest, for silages with high grain-content. The nonheading Funk's G-1990 had the lowest CP values and the highest fiber values. In general, the high moisture, late maturing hybrids produced silages with high total fermentation acids and the highest in-silo DM losses.

Trial 1. Performance by calves fed three whole-plant silage rations is shown in Table 37.3. The grain sorghum hybrid (DeKalb E67) gave superior daily gain and intake. The moderate grain content forage sorghum hybrid (Pioneer 947) supported intermediate daily gain and intake, but was equal to the grain hybrid in efficiency.

The nonheading G-1990 produced very low daily gain and intake and gave the worst feed efficiency of the three silages.

Trial 2. The grain sorghum hybrid (DeKalb 42Y) gave better cattle performance when compared with the two forage sorghums (Table 37.3). Daily gain and intake were highest for DeKalb 42Y silage. The low grain-yielding forage hybrid (DeKalb 25E) and Funk's G-1990 supported comparable daily gains and intakes, but feed efficiency for the nonheading forage sorghum was the poorest of the three silages.

Trial 3. In this trial, cattle fed the grain sorghum silage (DeKalb 42Y) outperformed those fed the moderate grain-yielding forage sorghum (Buffalo Canex) and the low grain-yielding forage sorghum (DeKalb 25E) for both daily gain and intake (Table 37.3). Buffalo Canex silage supported better gain and intake than DeKalb 25E. Efficiency of gain was equal among all three hybrids. Note that no nonheading silage was included in this trial.

Trial 4. The three grain sorghum hybrids (Funk's 550, NK2778, DeKalb 42Y) produced the highest daily gains (Table 37.4). The moderate grain-yielding forage sorghum hybrids (Buffalo Canex, Acco 351, Pioneer 947) produced respectable gains: over 2 lb per day. The low grain-yielding forage sorghum hybrid (DeKalb 25E) produced the poorest gain of the seven hybrids.

Calves consumed more of the grain sorghum silage rations than the forage sorghum silages, and the intake of the low grain-yielding hybrid was quite low (only 2.0% of body wt.). Efficiency of gain was virtually the same for all hybrids with the exception of DeKalb 25E, which produced the least efficient gain.

Based on 4 years of data, it is doubtful that nonheading sorghums have a place in growing programs. Also, the reduced daily gains with low grain-yielding forage sorghums may limit their use in growing rations. Relative feeding values (RFV) were assigned to each sorghum type based upon comparative rates and efficiencies of gain, with performance by cattle fed the DeKalb grain sorghum hybrids given a value of 100. Nonheading and low grain-content forage sorghum silages had RFV's of 66 and 78, respectively, while moderate to high grain-content forage sorghum silages had an average RFV of 95. Considering the excellent rate and efficiency of gains, grain sorghums may be more valuable in whole-plant silage rations than when the crop is harvested for grain.

Feeding comparisons with seven grain-producing forage sorghums and three grain sorghums, all harvested as whole-plant silage, will be presented next year.

Table 37.1. Hybrid Types, Harvest Dates, and Dry Matter (DM) and Crude Protein (CP) Contents at Harvest

| Year, Trial, and Hybrid | Hybrid Type | Harvest Date | Whole-plant % DM | Whole-plant % CP |
|---|---|---|---|---|
| 1982 (Trial 1): | | | | |
| Funk's G-1990 | Forage[1]3 | Oct. 4 | 24.0 | 6.5 |
| Pioneer 947 | Forage[3] | Sept. 23 | 31.0 | 8.6 |
| DeKalb E67 | Grain | Sept. 20 | 37.0 | 8.9 |
| 1983 (Trial 2): | | | | |
| Funk's G-1990 | Forage[1]2 | Sept. 29 | 27.1 | 5.9 |
| DeKalb 25A | Forage[2] | Sept. 27 | 29.2 | 6.0 |
| DeKalb 42Y | Grain | Aug. 28-30 | 42.1 | 10.7 |
| 1984 (Trial 3): | | | | |
| Buffalo Canex | Forage[3]2 | Aug. 27-28 | 30.8 | 8.0 |
| DeKalb 25E | Forage[2] | Oct. 2 | 25.8 | 7.2 |
| DeKalb 42Y | Grain | Sept. 4 & 26 | 41.3 | 9.6 |
| 1985 (Trial 4): | | | | |
| Buffalo Canex | Forage[3]3 | Sept. 16 | 28.0 | 8.5 |
| Acco Paymaster 351 | Forage[3]3 | Sept. 26-27 | 32.6 | 8.8 |
| Pioneer 947 | Forage[2] | Sept. 27 | 37.0 | 7.8 |
| DeKalb 25E | Forage[2] | Oct. 31 | 30.4 | 7.0 |
| Funk's 550 | Grain | Sept. 16 | 38.0 | 11.5 |
| Northrup King 2778 | Grain | Sept. 19 | 39.0 | 10.3 |
| DeKalb 42Y | Grain | Oct. 7 | 44.0 | 10.3 |

[1]Nonheading forage sorghum.
[2]Low grain-content forage sorghum.
[3]Moderate to high grain-content forage sorghum.

Table 37.2. Chemical Analyses of the Forage and Grain Sorghum Silages Fed in Trials 1, 2, and 3

| Item | Trial 1 (1982) Funk's G-1990 (NH[1]) | Trial 1 (1982) Pioneer 947 (F) | Trial 1 (1982) DeKalb E67 (G) | Trial 2 (1983) Funk's G-1990 (NH) | Trial 2 (1983) DeKalb 25E (F) | Trial 2 (1983) DeKalb 42Y (G) | Trial 3 (1984) DeKalb 25E (F) | Trial 3 (1984) Buffalo Canex (F) | Trial 3 (1984) DeKalb 42Y (G) |
|---|---|---|---|---|---|---|---|---|---|
| Silage DM, % | 22.0 | 37.0 | 36.0 | 24.9 | 25.1 | 42.3 | 24.75 | 29.8 | 42.3 |
| pH | 4.10 | 3.90 | 4.19 | 3.75 | 3.82 | 4.19 | 3.58 | 3.67 | 4.13 |
| | % of the Silage DM | | | | | | | | |
| Lactic Acid | 2.77 | 4.62 | 5.10 | 9.61 | 8.78 | 5.92 | 4.60 | 4.88 | 3.58 |
| Acetic Acid | 6.00 | 1.75 | 1.61 | 3.01 | 2.43 | 1.54 | 2.57 | 1.56 | 2.04 |
| Butyric Acid | .09 | .01 | .01 | <.01 | <.01 | <.01 | <.01 | <.01 | .08 |
| Total Fermentation Acids | 10.3 | 6.5 | 6.8 | 12.7 | 11.3 | 7.5 | 7.3 | 6.5 | 5.8 |
| Acid Detergent Fiber | 41.1 | 31.2 | 27.5 | 40.3 | 38.8 | 23.3 | 34.5 | 27.1 | 26.5 |
| Neutral Detergent Fiber | 66.4 | 55.6 | 42.9 | 64.9 | 63.9 | 40.1 | 63.0 | 53.5 | 41.7 |
| Crude Protein | 6.5 | 8.6 | 9.0 | 6.1 | 6.2 | 10.9 | 7.4 | 8.1 | 9.8 |
| | % of the Total Silage Nitrogen | | | | | | | | |
| Ammonia-N | -- | -- | -- | 5.2 | 4.2 | 6.5 | 4.0 | 2.9 | 6.1 |
| Hot Water Insoluble-N | 36 | 62 | 47 | 55 | 47 | 47 | 47 | 66 | 62 |

[1]NH = nonheading, F = forage sorghum, G = grain sorghum.

Table 37.3. Performance by Cattle Fed the Forage and Grain Sorghum Silage Rations in Trials 1, 2, and 3

| Item | Trial 1 (1982) | | | Trial 2 (1983) | | | Trial 3 (1984) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Funk's G-1990 (NH[1]) | Pioneer 947 (F) | DeKalb E67 (G) | Funk's G-1990 (NH) | DeKalb 25A (F) | DeKalb 42Y (G) | DeKalb 25E (F) | Buffalo Canex (F) | DeKalb 42Y (G) |
| No. of Cattle | 16 | 16 | 16 | 20 | 20 | 20 | 16 | 16 | 16 |
| Initial Wt., lb | 452 | 453 | 453 | 572 | 572 | 573 | 576 | 592 | 593 |
| Avg. Daily Gain, lb[2] | .95[c] | 1.77[b] | 2.12[a] | 1.25[b] | 1.37[b] | 2.25[a] | 1.75[c] | 2.16[b] | 2.37[a] |
| Avg. Daily Feed, lb[2] | 8.4[c] | 11.9[b] | 15.0[a] | 12.6[b] | 12.0[b] | 19.4[a] | 13.4[c] | 16.9[b] | 18.5[a] |
| Feed/lb of Gain, lb[2] | 9.0[b] | 6.8[a] | 7.1[a] | 10.1[b] | 8.9[a] | 8.7[a] | 7.8 | 8.0 | 8.0 |
| Relative Feeding Value[3] | 60 | 94 | 100 | 71 | 79 | 100 | 88 | 95 | 100 |

[a,b,c]Means within a trial with different superscripts differ (P<.05).

[1]NH = nonheading, F = forage sorghum, G = grain sorghum.
[2]100% dry matter basis.
[3]Based upon comparative rates and efficiencies of gain, with performance by cattle fed DeKalb grain sorghum silages assigned a value of 100.

Table 37.4. Performance by Cattle Fed the Forage and Grain Sorghum Silage Rations in Trial 4 (1985)

| Item | Forage Sorghum Hybrid | | | | Grain Sorghum Hybrid | | |
|---|---|---|---|---|---|---|---|
| | DeKalb 25E | Buffalo Canex | Acco 351 | Pioneer 947 | Funk's 550 | NK 2278 | DeKalb 42Y |
| No. of Calves | 8 | 8 | 8 | 8 | 8 | 8 | 8 |
| Initial Wt., lb | 541 | 538 | 533 | 536 | 535 | 543 | 542 |
| Avg. Daily Gain, lb[1] | 1.34[d] | 2.09[c] | 2.15[bc] | 2.03[c] | 2.53[a] | 2.46[ab] | 2.45[ab] |
| Avg. Daily Feed, lb[1] | 12.7[c] | 14.4[b] | 15.0[b] | 14.6[b] | 17.7[a] | 17.8[a] | 18.1[a] |
| Feed/lb of Gain, lb[1] | 9.6[b] | 6.9[a] | 7.0[a] | 7.2[a] | 7.0[a] | 7.2[a] | 7.5[a] |
| Relative Feeding Value[2] | 66 | 97 | 97 | 93 | 105 | 102 | 100 |

[a,b,c]Means within a trial with different superscripts differ (P<.05).
[1]100% dry matter basis.
[2]Based upon comparative rates and efficiencies of gain, with performance by cattle fed DeKalb grain sorghum silages assigned a value of 100.