EFFECT OF GRAIN CONTENT ON THE NUTRITIVE VALUE OF WHOLE-PLANT GRAIN SORGHUM SILAGE

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Summary

This experiment was conducted to determine the effect of grain content on the nutritive value of whole-plant grain sorghum silage. Silage dry matter (DM), organic matter (OM), and crude protein (CP) contents increased with increasing levels of grain in the reconstituted, whole-plant silages, whereas neutral detergent fiber (NDF) and acid detergent fiber (ADF) contents decreased as the level of grain increased from 0 to 48%. When fed to sheep (used as a model), voluntary DM intake and DM and OM digestibilities increased in a linear manner, whereas ADF digestibility decreased with increasing level of grain. Crude protein and NDF digestibilities responded in a quadratic fashion to increasing grain content. These results suggest that the optimum level of grain in whole-plant grain sorghum silage is at least 48% of the DM in a high silage-based ration.

(Key Words: Grain Sorghum, Silage, Silage Grain Content, Silage Nutritive Value.)

Introduction

Grain sorghum hybrids commonly are selected for grain yield potential and not necessarily for their silage traits. Previous research has shown that sorghum hybrids (both grain and forage) that contain a high proportion of grain in the whole plant DM are generally superior nutritionally to those with a low grain content (KAES Reports of Progress 678, page 16 and 704, pages 74 and 77).

We compared an all-stover grain sorghum silage (grain removed) with silage reconstituted to contain approximately 12 to 48% grain (DM basis).

Experimental Procedures

DeKalb 42Y grain sorghum was planted on June 7 near the Kansas State University campus at Manhattan in Reading silt loam soil at a seeding rate of approximately 35,200 plants per acre. Anhydrous ammonia was applied prior to planting at 100 lb per acre. Furadan 15G insecticide was applied in the furrow at planting, and Ramrod atrazine was applied as a preemergance herbicide. The hybrid was grown under dryland conditions and harvested at the late-dough stage of kernel maturity.

Three days before harvest, 30 randomly selected whole plants were taken from a cross section of the experimental plot. The fresh plants were weighed and separated into head and stover fractions. Fresh weights of the separated parts were recorded, and samples of each were dried to determine their approximate proportions in the whole-plant DM.

The remaining plants were harvested on September 6. The heads were removed by hand, leaving the stover portion. The heads and stover then were chopped separately with a FieldQueen, precision, forage harvester. The chopped heads and stover were combined to provide 12, 24, 36, and 48% grain in the reconstituted material (DM basis) and mixed in a Harshfi mixer wagon. Stover without grain also was used. All silages were made in polyethylene lined, 55-gallon drum, pilot-scale silos.

After about 90 days of storage, a voluntary intake and digestion trial was conducted to determine the nutritive value of the five silages. Because quantities of silage were too small for cattle, sheep were used as a model. Thirty wether lambs were blocked by weight and individually housed in metabolism crates, which were located in a climate controlled room. The five silages were assigned randomly within each block. Rations contained 90% silage and 10% supplement (DM basis) and were formulated to provide 11.0% CP (DM basis) with ground corn, soybean meal, and urea. Rations supplied equal amounts of calcium; phosphorus; trace minerals; and vitamins A, D, and E. The trial consisted of a 7-day adaptation, 7-day voluntary intake, 2-day transition, and 5-day total fecal collection phases. During the transition and collection phases, all lambs were restricted to 90% of their mean voluntary DM intakes.

Results and Discussion

The pH, DM content, and chemical composition of the five silages are presented in Table 1. All silages were well preserved, as evidenced by low pH values. Silage DM, OM, and CP contents increased, whereas NDF and ADF contents decreased with increasing levels of grain in the reconstituted silages.

Voluntary DM intake and digestibilities of DM, NDF, and ADF are shown in Figures 1 through 4, respectively. Digestibilities of CP and OM are not shown. Voluntary DM intake and DM and OM digestibilities increased in a linear manner with stepwise increases in the grain content in the reconstituted silages. Crude protein and NDF digestibilities responded in a quadratic fashion to increasing levels of grain. Acid detergent fiber digestibility increased slightly between the 0 and 12% levels of grain and then decreased gradually as the level of grain increased to 48%.

The optimum level of grain in the reconstituted, whole-plant, grain sorghum silages was at least 48%, at which DM intake was highest (53.8 g per kg $BW^{.75}$) and DM and OM digestibilities reached their maxima (64.6 and 65.1%, respectively). These results are consistent with a previous study in which the optimum level of grain in whole-plant corn silage to maximize the nutritive value was about 52.5% (KAES Report of Progress 704, page 70).

Table 1. pH, DM Content, and Chemical Composition of the All-Stover and Four Reconstituted, Whole-Plant, Grain Sorghum Silages [a]

Grain Content, % of the Whole-Plant Silage	pH	DM	CP	NDF	ADF	OM
		%	% of the silage DM			
0	3.84	24.7	6.1	59.3	32.4	85.3
12	3.80	29.7	6.6	55.0	31.0	87.6
24	3.76	31.9	7.5	57.7	30.1	89.0
36	3.75	35.6	8.1	52.1	27.2	90.4
48	3.74	41.7	8.3	40.3	21.6	90.8

[a]DM = dry matter, CP = crude protein, NDF = neutral detergent fiber, ADF = acid detergent fiber, and OM = organic matter.

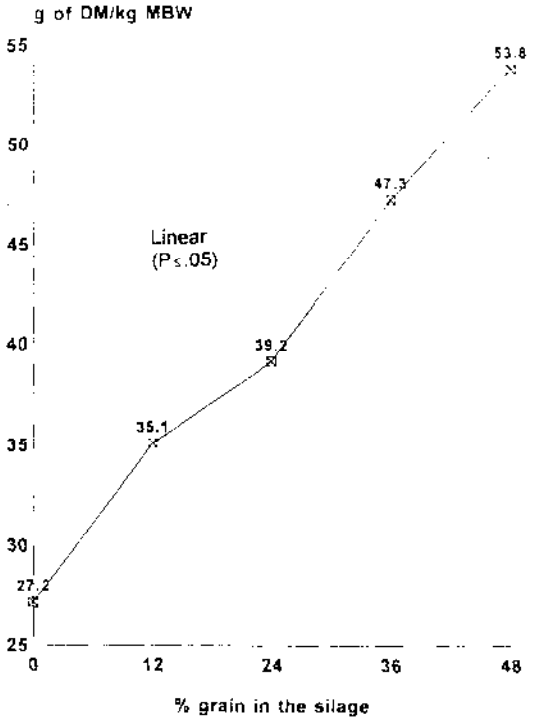

Figure 1. Effect of Grain Content on Voluntary DM Intake by Lambs. MBW is $BW^{.75}$

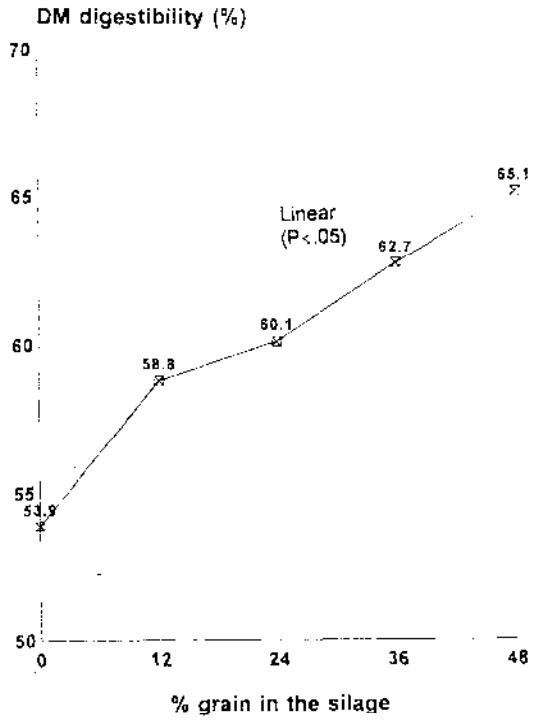

Figure 2. Effect of Grain Content on DM Digestibility by Lambs

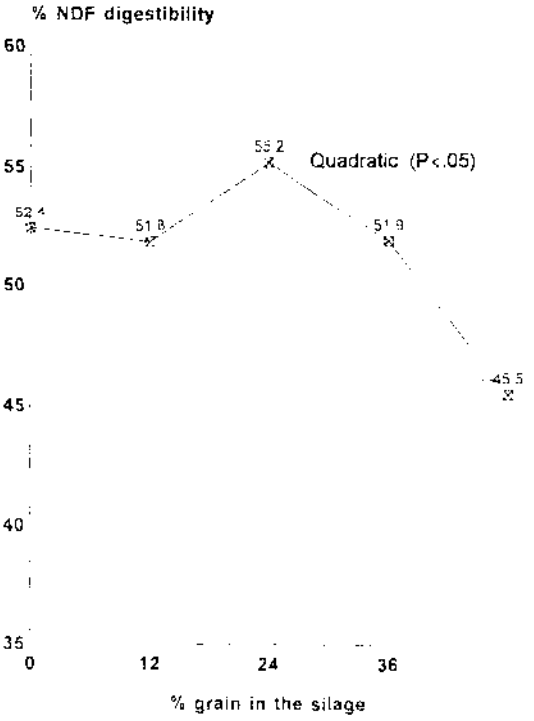

Figure 3. Effect of Grain Content on NDF Digestibility by Lambs

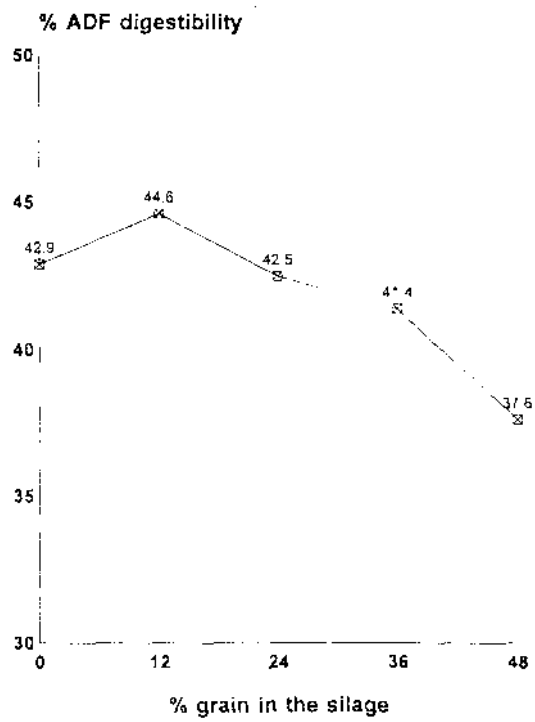

Figure 4. Effect of Grain Content on ADF Digestibility by Lambs