Kansas Agricultural Experiment Station Research Reports

Volume 0
Issue 1 *Cattleman's Day (1993-2014)*

Article 661

1994

Effect of grain content on the nutritive value of whole-plant corn silage

R.N. Jr. Sonon

B.S. Dalke

D.L. Holthaus

See next page for additional authors

Recommended Citation

Sonon, R.N. Jr.; Dalke, B.S.; Holthaus, D.L.; Pfaff, L.; Bolsen, K.K.; and Young, Matthew A. (1994) "Effect of grain content on the nutritive value of whole-plant corn silage," *Kansas Agricultural Experiment Station Research Reports*: Vol. 0: Iss. 1. https://doi.org/10.4148/2378-5977.2064

Effect of grain content on the nutritive value of whole-plant corn silage

Abstract

This experiment was conducted to determine the effect of grain content on the nutritive value of corn silage. Whole-plant silage dry matter (DM) increased, whereas neutral detergent fiber (NDF) and acid detergent fiber (ADF) contents decreased as the level of grain increased from 0 to 65% in the reconstituted, whole-plant, corn silages. Using sheep as a model, voluntary DM intake and DM and organic matter (OM) digestibility increased, but crude protein (CP) and ADF digestibilities decreased linearly as grain content increased from 0 to 52.5%. Our results indicate that the optimum level of grain in whole-plant corn silage to maximize the nutritive value of a high silage-based ration was about 52.5%.

Keywords

Cattlemen's Day, 1994; Kansas Agricultural Experiment Station contribution; no. 94-373-S; Report of progress (Kansas State University. Agricultural Experiment Station and Cooperative Extension Service); 704; Beef; Corn; Silage; Grain content; Nutritive value

Authors

R.N. Jr. Sonon, B.S. Dalke, D.L. Holthaus, L. Pfaff, K.K. Bolsen, and Matthew A. Young

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

R. N. Sonon, Jr., B. S. Dalke, D. L. Holthaus, M. A. Young, L. Pfaff, and K. K. Bolsen

Summary

This experiment was conducted to determine the effect of grain content on the nutritive value of corn silage. Whole-plant silage dry matter (DM) increased, whereas neutral detergent fiber (NDF) and acid detergent fiber (ADF) contents decreased as the level of grain increased from 0 to 65% in the reconstituted, whole-plant, corn silages. Using sheep as a model, voluntary DM intake and DM and organic matter (OM) digestibility increased, but crude protein (CP) and ADF digestibilities decreased linearly as grain content increased from 0 to 52.5%. Our results indicate that the optimum level of grain in whole-plant corn silage to maximize the nutritive value of a high silage-based ration was about 52.5%.

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

Introduction

Typically, corn hybrids are selected for grain yield potential and not necessarily for their silage traits. There is a long-standing belief that the nutritive value of corn silage increases as the proportion of grain in the whole-plant silage increases. However, in two recent studies, we found that higher grain-containing corn silages were not always nutritionally superior to those with less grain (KAES Reports of Progress 592, page 110, and 678, page 19).

We compared all-stover silage with silage reconstituted to contain 27.5 to 60% grain.

Experimental Procedures

Cargill 6227 corn hybrid was planted on May 18, 1992 near the Kansas State University campus at Manhattan, on a Reading silt loam soil at a seeding rate of approximately 27,110 plants/acre. Anhydrous ammonia was applied preplant at 100 lb/acre, and 2.0 lb/acre of Ramrod-atrazine was applied at planting time. The hybrid was grown under irrigation and harvested at about 85% milk line stage of kernel maturity.

Three days before harvest, 30 whole plants were taken randomly from a cross section of the 118 × 690 ft experimental plot. The fresh whole plants were weighed and separated into grain, cob, and stover fractions. Fresh weights of the separated parts were recorded, and samples of the parts were dried to determine plant part proportions in the whole-plant DM.

The remaining plants were harvested on September 13, 1992. The ears were removed by hand, leaving the stover portion of the plant (including the husk). The ears and stover were chopped separately with a Fieldqueen, precision, forage harvester. The chopped ears and stover were combined to provide 27.5, 40.0, 52.5, and 65.0% grain in the reconstituted, whole-plant material (DM basis), and mixed in a mixer wagon. The silages, including an all-stover silage, were made in polyethylene-lined, 55-gallon barrels.

After about 90 days of storage, a voluntary intake and digestion trial was conducted to determine the nutritive value of the five silages. Because of the limited amount of silage we could make in barrels, sheep

were used as model animals. Thirty wether sheep were blocked by weight and individually housed in metabolism crates. The five silages were assigned randomly in each block. Rations contained 90% silage and 10% supplement (DM basis) and were balanced to 11.5% crude protein (DM basis) with ground corn grain, soybean meal, and urea. Rations supplied equal amounts of calcium, phosphorus, and vitamins A, D, and E. The trial consisted of 7-day adaptation, 7-day voluntary intake, 2-day transition, and 6-day total fecal collection phases. During transition and collection phases, all sheep were fed 90% of their mean voluntary DM intakes.

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

Grain	pH	DM	CP	NDF	ADF
%		%	————% of the silage DM————		
0	3.53	27.1	6.3	66.0	43.2
27.5	3.58	28.8	6.8	48.1	37.2
40.0	3.65	31.2	7.4	44.0	29.4
52.5	3.71	35.9	7.8	40.7	25.4
65.0	3.98	40.5	7.6	38.1	20.1

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

Table 2. Chemical Composition of the Rations Fed to Sheep in the Voluntary Intake and Digestion Trial [a]

Grain	OM	CP	NDF	ADF
%	————————% of the ration DM————————			
0	90.9	12.0	60.8	39.5
27.5	91.3	11.5	45.0	34.2
40.0	92.9	11.0	41.0	27.1
52.5	93.9	11.0	37.8	22.5
65.0	94.8	11.2	35.6	18.6

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

Grain content was used to predict voluntary DM intake; digestibilities of DM, CP, NDF, and ADF, and percent digestible organic matter.

Results and Discussion

The pH, DM content, and chemical composition of the five silages and chemical composition of the five rations are presented in Tables 1 and 2, respectively. All silages were well preserved, as evidenced by low pH values. Silage DM and OM contents in-

creased, whereas NDF and ADF contents decreased with increasing levels of grain in the reconstitute d silages. Crude protein content increased as grain in the silage increased.

Voluntary DM intake and digestibilities of DM, NDF, and ADF for the five silage rations fed to sheep are presented in Figures 1 through 4, respectively. Digestibility of CP and percent digestible organic matter are not shown. Regression analyses indicated that voluntary DM intake; digestibilities of DM, CP, and ADF; and percent digestible organic matter responded linearly to increasing grain content in the reconstituted, whole-plant silages. The greatest response to grain addition occurred from 0 to 27.5% grain. Voluntary DM intake increased by 12.6% between the increments from 27.5 to 40.0 and 40.0 to 52.5% grain in the silage. DM digestibility increased by 2.8 and 4.7 percentage units, when grain levels in the silage were increased from 27.5 to 40.0% and 40.0 to 52.5%, respectively. Crude protein and ADF digestibilities decreased with increasing grain content, whereas NDF digestibility showed a quadratic response. Grain content had only a modest effect on the digestibility of these nutrients.

The optimum level of grain in the reconstituted, whole-plant corn silages was 52.5%, at which DM intake was highest (62.5 g/kg BW $^{.75}$) and DM and OM digestibility approached their maxima (66.2 and 68.2%, respectively), with only slight numerical increases at 65.0% grain content. This is supported by the high predictive power of grain content for percent digestible OM (r^2=.846) and DM digestibility (r^2=.791).

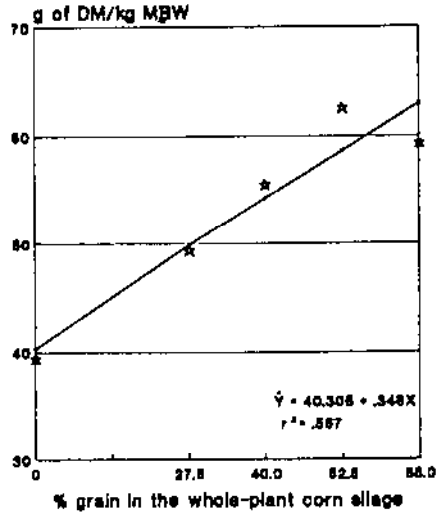

Figure 1. Effect of Grain Content on Voluntary DM Intake of Sheep. MBW is BW $^{.75}$

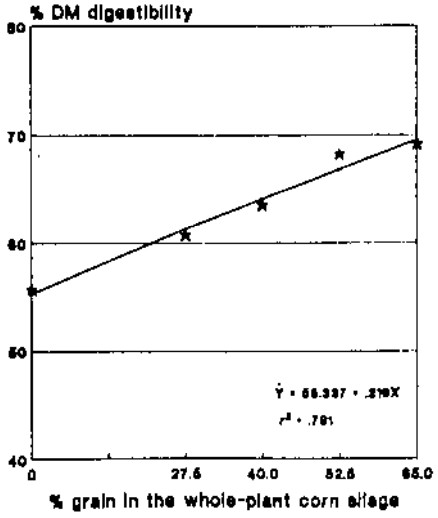

Figure 2. Effect of Grain Content on DM Digestibility in Sheep

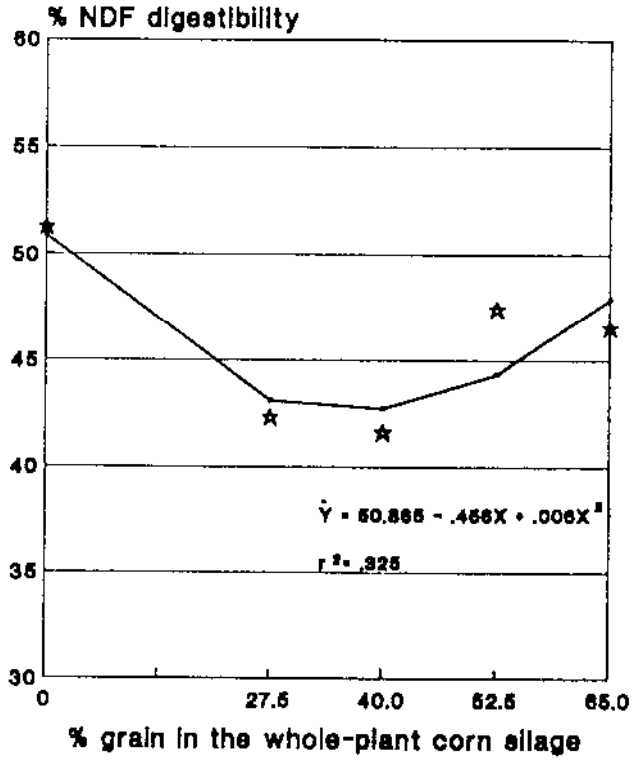

Figure 3. Effect of Grain Content on NDF Digestibility in Sheep

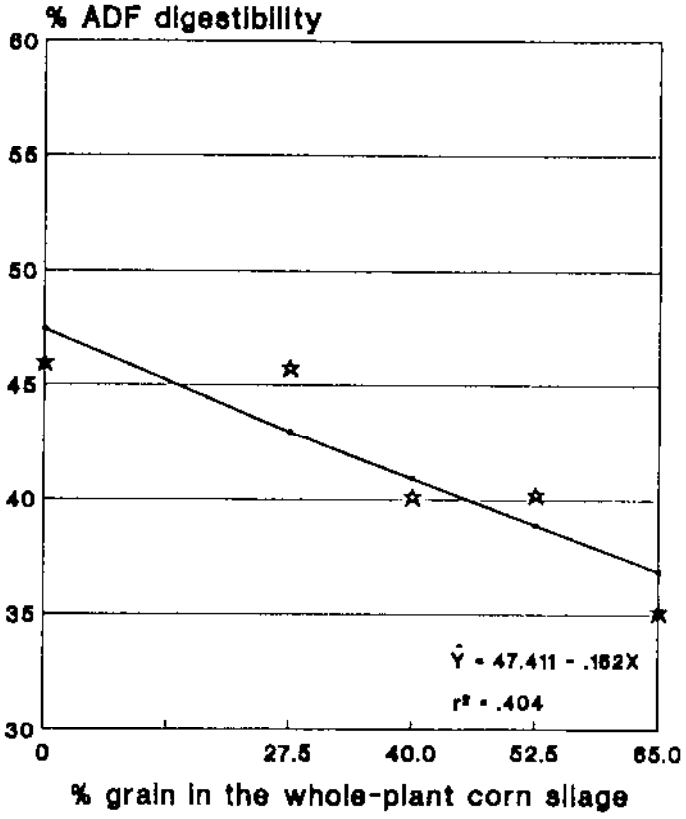

Figure 4. Effect of Grain Content on ADF Digestibility in Sheep