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Summary

New corn residue harvesting methods were evaluated to determine the impacts of altering the proportions of plant part that are composed in a round bale. In vitro techniques were used to assess the organic matter digestibility of corn residue bale harvested with different proportions of stalks, leaves, and husk. As husk comprised a greater proportion of the bale, digestibility appeared to increase when compared with a conventional bale of cornstalks.

Introduction

Studies have shown the digestibility of the different parts of a corn plant differ, with the husk being the most digestible and the stalk being the least digestible (*2012 Nebraska Beef Cattle Report,* pp. 11-12). Advancements in harvest technology of the residues are now allowing the producer to decrease the amount of the stalk in the bale, compared to conventional baling methods. The objective of this trial was to determine if the harvest method has an impact on the digestibility and quality of the bale produced.

Procedure

Three harvest methods were utilized to obtain samples, with five replicates per sample. Samples included: husk, 2-, 4-, 6-, and 8-row bales. Husks were obtained from Hoegemeyer Seed. Husks were sifted through a 3 ft by 5 ft metal screen by hand to remove any remaining corn. In order to obtain the bales of 2, 4, 6, and 8 rows, a New Holland Cornrower Corn Head was used. The Cornrower head has attachments that cut the stem and blow them into a windrow between the wheels of the combine. The straw spreader is disengaged, so the residue exiting the combine falls on top of the windrow made of the stalks. The number of rows of stalks cut can be adjusted from 0 to 8 (8-row head). The material exiting the combine includes all of the cobs, most of the husks, some leaves, and some of the upper 1/3 of the stems. The Cornrower corn head allows for the producer to select how many corn rows go into the windrow, allowing different proportions of plant parts to be present in the bale. The 8-row bale includes all of the stem material and, therefore, may be equivalent to conventionally baled stalks. However, essentially all the residue exiting the combine is recovered with the Cornrower head and, therefore, more husk may be included than conventionally baled stalks. A sample of conventionally baled stalks from another field is included for comparison. The yield of stover DM per acre was calculated by weighing bales from the field, measuring the linear feet of windrow in the bale, and calculating the area that the windrow represented in the field by counting rows. Bale weights were corrected for DM.

Samples were dried in a 60°C oven for 48 hours, where they were then ground through a 1mm screen. An assay for *in vitro* OM (IVOMD) digestibility was then preformed on the samples. Test tubes were utilized to hold 0.5 grams of each sample and 50mL of an inoculum. The inoculum for the procedure was a combination of ruminal fluid from two donor steers that were consuming a 70:30 roughage: concentrate diet (DM basis). Ruminal fluid was filtered through four layers of cheesecloth to help eliminate excess feed particles. McDougall's buffer was mixed into the ruminal fluid at a 1:1 ratio, along with the inclusion of 1 gram of urea/L.

Once the test tubes were filled with the appropriate mixtures, they were placed in a water bath at 600°F for 48 hours to allow fermentation. To end fermentation, each test tube received 6 mL of 20% HCL then 2mL of 5% pepsin solution. Tubes were then returned to the water bath for an additional 24 hours. At the end of the 24 hours, the tubes were removed from the water bath and the residue was filtered through a non-ash filter. Filters containing the residues were placed in an oven at 212°F to dry to obtain the IVDMD. After obtaining the IVDMD, filters were placed into a cool muffle furnace at 1112°F for a minimum of six hours. The residue left allowed for calculation of IVOMD. Data were analyzed using the MIXED procedure of SAS (SAS Institute, Inc., Cary, N.C.). The response variable was IVOMD, with the tube being the experimental unit.

Results

Table 1 from McGee et al., (*2012 Nebraska Beef Cattle Report,* pp.11-12*)* is included to illustrate the digestibility and proportions of the individual corn plant parts. Husks are the most digestible part but are a small proportion of total plant weight. Conversely, stems represent a large proportion but are low in digestibility. The upper 1/3 of the stem is more digestible than the lower 2/3. Visual observation is that some of the upper stem goes through the combine. The IVOMD of the husk was significantly greater ($P < 0.01$) compared with the four bales (Table 2). When comparing the four bales produced with the Cornrower corn head, IVOMD

Table 1. Plant part IVDMD, % of total plant DM, and lb DM/bu grain.[1]

Plant Part	IVDMD	% of Plant DM	lb/bu
Top 1/3 stalk	37.57%	3.60%	1.21
Bottom 2/3 stalk	33.85%	41.83%	14.12
Leaf	45.70%	18.83%	6.30
Leaf sheath	38.56%	12.60%	4.23
Husk	59.03%	7.48%	2.51
Shank	49.75%	1.09%	0.37
Cob	34.94%	14.68%	4.93

[1]McGee et al., *2012 Nebraska Beef Cattle Report,* pp.11-12.

Table 2. The effect of harvest method on IVOMD.

Item	Husk	2 Row	4 Row	6 Row	8 Row	Conventional Stalks	SE	*P*-value
IVOMD	72.4%[a]	66.4%[b]	54.3%[c]	53.3%[c]	47.0%[d]	43.0%	0.01	<0.01
DM Stover yield, lb/acre	—	1188	1469	2973	3336	—	—	—

increased as the number of rows collected in the bale decreased, presumably because of the increase proportion of husk and leaf. A difference ($P < 0.01$) was seen between the 2-row and the 4-row bale with IVOMD of 66% and 54%, respectively. There was no difference ($P > 0.05$) between the 4- and 6-row bales (IVOMD of 54% and 53%, respectively). The 8-row bale had an IVOMD of 47%, differing ($P < 0.01$) from the 6-row bale. From the IVOMD, the harvest method appears to affect the digestibility of the residue being fed. The differences in IVOMD are likely due to changing the proportion of husk, leaf, and cob compared to the proportion of stem in the bale. As the number of rows in the windrow is reduced, the proportion of leaf and husk increases and the proportion of stem decreases, thereby increasing digestibility. It is unclear if an increased proportion of cob falls through the windrow as the number of rows is reduced. However, reducing the proportion of stem also affects the yield of stover harvested from a field. The DM stover yield per acre was reduced from 3,336 lb/acre to 1,188 lb/acre as the rows of stem collected in the bale decreased from 8 to 2. Reducing the proportion of stem in baled residue increases forage digestibility but decreases forage yield harvested from corn fields.

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