Iowa State Beef Checkoff Research Program
Final Report

Title of project:

Impact of chopping corn residue during grain harvest on cattle performance when grazing residue.

Investigators:

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Introduction

The use of chopping heads on combines have has increased in the last decade. The idea behind these combine heads is to reduce the particle size of the corn residue. In reducing the particle size of the residue, it increases the surface area and allows soil microbes greater access to the fibers to break them down. A large portion of our data supporting stocking rates for grazing corn residue pre-dates the use of chopping combine heads.

An advantage of grazing residue compared to baling, is the animal's ability to select the more digestible plant parts. When grazing corn residue, cattle first select any grain remaining after harvest, followed by the husks, and finally the leaves. However, chopping may limit their ability to select individual plant parts, significantly decreasing the energy content of their diet. Previous research has shown that when selectivity is limited, such as with baled corn residue, cows cannot meet their energy and protein needs. The smaller particle size may also increase residue degradation rate and thus result in lower feeding value later in the grazing season. ***Understanding the feeding value of the chopped residue for grazing would allow cattle producers to adapt their management strategy to match cattle nutritional needs with the available resources.***

Thus, the objectives of this project were to:

1.Compare cattle selectivity and performance as well as corn residue degradation rate of corn residue from corn harvested without a chopping head and corn residue harvested with a chopping head.

2.Provide education to cattle producers about grazing corn residue and how to adapt management to match cattle nutritional needs.

Materials and Methods

The study was conducted at the Eastern Nebraska Research Extension and Education Center, near Mead, NE. On a 26-acre irrigated field in a corn-soybean rotation was divided into 8, 2.6-acre paddocks for grazing and 4, 1.3-acre paddocks for ungrazed treatments, equally split on the east and west half of the field. Within each half of the field the 4 grazed paddocks and the 2 ungrazed areas were assigned randomly to harvest method (STD or CHP). The corn was harvested on October 7, 2023, using a John Deere S650 rotary combine, and yielded 220 bushels per acre. A JD620F 20-foot flex header was used on the STD treatment, and a 2013 John Deere 608C Stalkmaster corn header was used on the CHP treatment.

Spring-born steers (n=40) weighing 507±7 lb were used in the trial to determine the value of residue that was by evaluating impacts of harvest method on average daily gain. These cattle were limit-fed at 2% of body weight for five days prior to the beginning of the trial to equalize gut fill and weighed the final three days of the limit feeding period and establish an initial body weight. Steers were implanted with Ralgro prior to the initiation of grazing. Following the limit-feeding period steers were stratified by weight and assigned randomly to a paddock.

Ruminally cannulated diet samplers (n=4) weighing 1067±72 lb were used to determine the quality of the diet that was selected by the cattle in this study. Since cattle are selective eaters, just using residue samples alone is not a good indication of what the cattle are ingesting. To obtain diet samples, the cannulated sampler first has its rumen evacuated of its contents. Once the contents are out, the cattle are turned out to graze for an hour and a half. After the grazing period is over, the rumen contents are emptied and taken as samples for in vitro digestion to determine the energy content of the diet and analyzed for

crude protein. This was conducted on the first day of the trial, on day 37 of the trial, and following the grazing on February 7th.

In the east half of the field six steers grazed each of the 4 paddocks . In the west half, one diet sampler replaced two of the growing steers resulting in 4 steers and one diet sampler in each of the 4 paddocks. This resulted in the same grazing pressure on a lb body weight per acre basis across all paddocks. All groups were supplemented with 18.3 lb/group/d (0.6% of initial body weight of the growing steers) of a dried distillers grains and mineral supplement. All steers and diet samplers had to be removed from the study on January 10th due to inclement weather (deep crusted snow). This resulted in a total grazing period of 56 days. Following removal, growing steers were again limit fed for five days, and had weights collected the final 3 days of limit feeding.

Corn residue availability was sampled at three time points throughout the trial in the grazed and ungrazed areas to determine losses from grazing and weathering. Samplings occurred the day before initial grazing (d -1; November 7), day 36 of grazing (December 14), and after the snow had melted following grazing on February 7 (28 days after the end of grazing). Residue was sampled in each paddock by sampling a single 8-row combine pass in the middle of the paddock. To account for distribution behind the harvester, the residue in 2.5 x 2.5 area was collected between rows two and three, four and five and six and seven at each sampling date in each paddock. Samples were dried in a 140-degree Fahernheit oven and oven dry weight was collected for each sample using the average to determine mass per acre.

Husk samples were collected in the same rows as the residue samples, by measuring areas that were 2.5 feet by 25 feet and collecting all the husk within that distance. These counts were used to determine the husk count per acre, and also for in vitro digestion to determine the energy and protein of the husks throughout the trial.

Following the collection of the samples in vitro digestion was conducted to determine the energy value using digestible organic matter (DOM). Crude protein (CP) of the samples was determined using combustion method. These procedures were conducted on the diets samples that were collected monthly and also the husk samples from the ungrazed areas. The reason the ungrazed husk was used rather than the grazed was because there was too little husk to evaluate following the second sampling.

Results and Discussion

Overall, the residue mass in the non-grazed portion of the field did not change ($P = 0.40$) over the winter and did not vary by harvest method ($P = 0.89$). In the grazed paddocks, there was no difference ($P = 0.58$) in the amount of residue mass between the harvest methods but as expected the residue mass decreased in both treatments over time ($P = 0.01$) as the steers consumed and trampled residue. Husk is the highest energy component of corn residue and also one of the most palatable. Husk is also very susceptible to wind loss.

When husk mass was evaluated in the non-grazed areas of the field there was a loss of husk over the winter ($P < 0.01$). This reduction in husk is likely due to wind loss. However, there were no difference in husk mass due to harvest method ($P = 0.39$), although at the start of the trial the CHP treatment numerically had 40% less husk. In the grazed areas, there was a difference in the amount of husk present between the harvest methods with CHP having 38% less husk mass than STD. However, after 36 days of graze very little husk remained in either harvest method, resulting in no differences due to harvest method.

For the diet samples collected from the cannulated steers (Table 2), there was no difference ($P \geq 0.21$) due to harvest method in the energy (DOM) or protein (CP) content selected. There was no change ($P = 0.67$) in the protein content of the diet selected over the winter. However, there was a tendency ($P = 0.11$) for the DOM content of the diet to be reduced over the winter. This is likely due to a combination of the change in husk availability forcing the cattle to select more leaf and possibly a change in the energy content of the plant parts. The husk obtained from the ungrazed areas of the field showed that the DOM content declined ($P < 0.01$) over the winter but there were no differences ($P = 0.50$) between the harvest methods. The protein content of husk did not change ($P = 0.18$) with time or harvest method ($P = 0.18$). Diet sample CP was higher and the DOM was lower than the husk samples suggesting that the cattle were consuming leaf in addition to husk throughout the grazing period.

The average daily gain of the growing steers grazing over the 56 days did not differ ($P = 0.20$) between the two harvest methods (Table 3). Gains were approximately half of what we would have expected given the amount of distillers supplement provided. This may be due to the extreme cold that occurred. The heavy crusted snow forced us to end graze 2 weeks (20%) earlier than targeted. Thus, we did not use the residue as fully as we typically recommend, potentially allowing for increased selectivity. We are repeating the animal performance component of the trial this year to ensure that the low performance is not masking any differences.

To conclude, based on our results the chopping corn residue does not appear to reduce grazing cattle selectivity or performance. However, there is decrease the nutrient content of diet selected as the winter progressed. A good portion (75%) of the husk can be lost even from ungrazed fields by the end of winter. This suggests that as the winter progresses, the diet of cattle even when moved to new fields will have less energy than early in the winter.

Outreach

An overview of the preliminary data was presented at the Three State Beef conference in Greenfield, IA in January of 2024 (28 participants) and the Iowa Forage and Grassland Council meeting (35 participants) in Ames, IA in February of 2024. These data were presented in the corn residue webinar series on reevaluating historic rules of thumb organized by the Iowa Beef Center in September of 2024. There were 50 participants online. The recording can be viewed at https://youtu.be/dkH3wbdZfsQ?si=oCSHBcJ8qjbZHaXi . Outside of Iowa we presented at events targeted at cattle producers: 1 in Nebraska reaching 92 participants and Missouri with 12 attendees. A poster was presented at 3 events in Nebraska: May beef extension group in-service training (30 people), Nebraska Cattlemen's meeting (20 people engaged), and the cover crop grazing conference (35 people).

We plan to include this winter's performance data and publish in a beef report in 2025.

Table 1. Mass (lb DM/ac) of corn residue over the winter that was harvested using two methods: a standard corn head (STD) or a chopping corn head (CHP)

	Nov 7		Dec 14		Feb 7		SEM	*P*-value		
Type	STD	CHP	STD	CHP	STD	CHP		Method x Time	Method	Time
Total mass										
Non-grazed	10,646	11,620	11,889	9,322	9,291	10,609	1,064	0.10	0.89	0.40
Grazed	10,331	10,796	10,827	9,507	8,630	8,619	729	0.36	0.58	0.02
Husk mass										
Non-grazed	1100	670	860	976	180	210	124	0.15	0.39	<0.01
Grazed	1168a	730b	25c	6.6c	0c	0c	121	0.04	0.05	<0.01

Corn harvest was on Oct. 7th. Grazing initiated on Nov. 8th and ended Jan 10th due to snow cover.
Means within a row lacking common letters differ ($P < 0.05$)

Table 2. Energy measured as digestible organic matter (DOM) and crude protein (CP) content of the diet selected by cannulated steers grazing corn residue that was harvested using two methods: a standard corn head (STD) or a chopping corn head (CHP)

	Nov 7		Dec 14		Feb 7		SEM	*P*-value		
Type	STD	CHP	STD	CHP	STD	CHP		HM x Time	HM	Time
Diet Sample										
DOM, % DM	55.5	56.3	52.0	53.6	48.2	44.3	3.80	0.75	0.89	0.11
CP, % DM	4.47	5.67	5.07	4.99	4.97	5.04	1.20	0.54	0.21	0.67
Husk Sample										
DOM, % DM	62.7	64.6	63.2	63.1	56.7	57.6	1.82	0.79	0.50	<0.01
CP, % DM	3.57	3.34	3.49	3.44	4.06	3.61	0.24	0.71	0.18	0.18

Table 3. steers grazing corn residue that was harvested using two methods: a standard corn head (STD) or a chopping corn head (CHP)

	STD	CHP	SEM	*P*-value
Initial BW, lb	508	508	1.63	0.88
End BW, lb	556	548	3.66	0.18
ADG, lb/d	0.83	0.69	0.069	0.20

Photo: Chopped corn residue on the left and standard corn residue on the right. Photo taken on November 18, 2023, 5 days after the start of grazing.

Photo: Standard corn husk on the top and chopped corn husk on the bottom.

Photo: Chopped corn residue on the left and standard corn residue on the right. Photo taken on January 6th, 2024 53 days after the start of grazing and 3 days before cattle were pulled off due to snow cover.

Photo: Snow cover at end of the grazing period.