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# Forage Quality and Grazing Performance of Beef Cattle Grazing Brown Mid-rib Grain Sorghum Residue

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## Summary

The control (CON) grain sorghum hybrid AWheatland x RTx430 and its near-isogenic brown midrib counterpart (BRM) containing the gene *bmr-12*, were used in a 72-day residue grazing experiment. Grain yield averaged 119 bu/ac and was not affected by treatment. ADG was increased from 0.75 lb in CON to 1.23 lb in BMR treatments over the grazing period. NDF digestibility increased 6%-12% units in leaf fractions in BMR over CON. NDF digestibility decreased 2%-12% units over the 72-day grazing period for both hybrids. Similarly, NDF digestibility of the stem fraction increased 14%-19% units in BMR over CON. NDF digestibility of the stem fractions remained constant, regardless of treatment, over time.

## Introduction

Many crop species have been successfully developed with the brown midrib trait which is associated with reduced lignin including corn, pearl millet, grain sorghum, and sudan-grass. However, to date, there has been little research on the effects of the brown midrib trait in grain sorghum. Previous research at the University of Nebraska (Oliver, et al., 2005 Crop Science) using the common grain sorghum hybrid AWheatland x RTx430, and its counterpart near-isogenic for the brown midrib gene *brm-12* showed no difference in grain yield and residue NDF content, but an improvement of *in vitro* NDF digestibility (IVNDFD) associated with the brown midrib trait. The objectives of our experiment was to determine if cattle performance was positively af-

ected by the brown midrib trait when grazing post-harvest grain sorghum residue, and to verify the previous small-plot results indicating no reduction in grain yield, but increased digestibility of similar NDF content, in a commercial-scale field experiment.

## Procedure

Forty-eight steers (550 ± 50 lb) were stratified by BW and assigned randomly to 5.75 acre paddocks containing the conventional grain sorghum hybrid AWheatland x RTx430 (CON) or its near-isogenic brown midrib counterpart (BMR) containing the gene *bmr-12*. Two treatments and four replications, for a total of eight paddocks were used. Steers were limit fed a 25% alfalfa, 25% grass hay, and 50% wet corn gluten feed diet for 5 days at the beginning and end of the trial and weighed consecutively for 2 days to minimize variation due to gut fill. Steers grazed from Nov. 27, 2006 to Feb. 7, 2007, stocked at approximately 1 AU/acre (5.75 acre/paddock with 6 steers/paddock). Over the course of the grazing period, steers were supplemented at 2.5 lb/steer daily. The supplement consisted of 93.8% dry distillers grain, 4.7% limestone, 0.8% tallow, 0.1% Rumensin-80, 0.3% beef trace mineral, 0.2% selenium, and 0.1% vitamin A-D-E. Each steer received approximately 10 lb grass hay during 3 days of substantial snow cover.

Grain was harvested with a commercial combine on Oct. 13, 2006, weighed in a commercial grain cart, and yields were adjusted to 14.5% moisture. Samples of the residue were collected on day 4 (Dec. 1, 2006), 30 (Dec. 26, 2006), and 60 (Jan. 26, 2007) of the grazing period. Small metal enclosures were placed in each paddock and sampled to allow a comparison to any change in residue quality over time when residue is not grazed. Residue sample was collected from 3 ft in each row in each paddock in the grazed and non-grazed areas. All samples were dried in a 60°C forced

air oven and separated into leaf, stem, and head fractions. After separating plant fractions, samples were ground and analyzed for NDF, IVNDFD (*in vitro* NDF digestibility), and CP.

NDF content was determined by agitating 0.50 g samples in heat sealed Ankom filter bags in 1,900 mL NDF solution (15 g/24 samples sodium sulfite was added to aid in protein degradation) for 75 minutes, rinsed in three, five-minute boiling distilled water rinses, dried and finally re-weighed.

*In vitro* NDF digestibility was determined by a 48-hour incubation of 0.3 g substrate in a 1:1 mixture of McDougal's buffer (1 g/L urea) and rumen fluid collected from steers fed a forage-based diet. Tubes were stoppered, flushed with CO<sub>2</sub>, incubated at 39°C and swirled every 12 hours. After 48 hours, the residue was refluxed for 1 h in 100 ml NDF solution (0.3 g sodium sulfite was added to aid in protein degradation), filtered, and dried for 24 hours. *In vitro* NDF digestibility was calculated as:  $1 - \{ [(Residue + Filter\ paper) - Filter\ paper] - blank \} / [(Sample\ Wt) \times (DM)] = IVNDFD (\%)$ . *In vitro* NDF digestibility was conducted to simulate a grazing occurrence by date.

All data were analyzed using the MIXED procedure of SAS. Lab data were analyzed as repeated measures with an auto-regressive (AR-1) covariance structure. Samples were analyzed for the effects of treatment, sample type (i.e., leaves and stems), day, and grazed versus non-grazed. Significance was determined by comparing the least square means for repeated measures ( $P < 0.05$ ).

## Results

### Grain Yield

Grain yields averaged 119 bu/ac across the entire experiment, and CON yields (122 bu/ac) were not significantly different from BMR yields (116 bu/ac;  $P > 0.05$ ).

(Continued on next page)

## Cattle Performance

At the end of grazing, BW ( $P < 0.01$ ) and ADG ( $P < 0.01$ ) were significantly different across treatments. Steers grazing the BMR residue gained more (1.23 lb/day) than CON (0.75 lb/day). This amounts to an increase of 0.48 lb/day for steers grazing grain sorghum residue with the BMR trait compared to CON.

## Neutral Detergent Fiber

Treatment caused no significant difference in NDF content of the leaf fraction in the nongrazed metal enclosures across date ( $P > 0.41$ ), averaging 67.6% for BMR and 66.9% for CON. Similarly, NDF of the stem fraction inside the metal enclosures was not different across treatment or date ( $P > 0.45$ ). The NDF content in stem fractions for BMR and CON averaged 75.6% and 75.3% respectively. The NDF content in the stem fractions across both treatments at day 60 was significantly higher compared to day 4 or day 30 ( $P < 0.05$ ), with NDF contents of 73.7%, 74.0%, and 76.4% for day 4, 30, and 60, respectively.

A similar interaction was observed across treatments and dates for NDF content of the leaf fraction in residue from grazed areas. NDF content averaged 69.8% for BMR and 69.1% for CON which is not significantly different between the two hybrid treatments ( $P > 0.20$ ). Additionally, leaf NDF was significantly higher in both treatments at day 60 ( $P < 0.01$ ) compared to day 4 and day 30 for grazed areas. Stem fractions, from grazed areas, were not significantly different ( $P > 0.20$ ) at any date or across treatments ( $P > 0.10$ ), averaging 75.6% for BMR and 75.3% for CON.

## In-Vitro NDF Digestibility

Interactions were observed between residue sample type, day in grazing period, grazed or non-grazed portions, and hybrid treatment. Therefore, simple effects of hybrid by residue sample type are presented by day in grazing period as well as collection from grazed or non-grazed areas (Table 2).

Regardless of whether samples were collected from grazed or non-grazed

**Table 1. Effect of grain sorghum hybrid on steer performance when grazing residue for 72 days.**

	CON	BMR	SEM	P-Value
Initial BW, lb	564	564	3	0.85
Final BW, lb	618	652	7	0.01
ADG, lb	0.75	1.23	0.08	0.01

**Table 2. Mean *In-vitro* NDF digestibility % for grazed and non-grazed portions of CON and BMR grain sorghum residue for the 72-day grazing period.**

GRAZED	Leaves			Stems		
	CON	BMR	P-Value	CON	BMR	P-Value
Day						
4	68.6 <sup>a</sup>	77.1 <sup>a</sup>	<0.01	59.1 <sup>a</sup>	77.3 <sup>a</sup>	<0.01
30	65.7 <sup>a</sup>	76.2 <sup>a</sup>	<0.01	60.3 <sup>a</sup>	75.9 <sup>a,b</sup>	<0.01
60	57.2 <sup>b</sup>	69.1 <sup>b</sup>	<0.01	59.5 <sup>a</sup>	73.3 <sup>b</sup>	<0.01
NON-GRAZED EX-CLOSURES						
Day	Leaves			Stems		
	CON	BMR	P-Value	CON	BMR	P-Value
4	69.9 <sup>a</sup>	76.0 <sup>a,b</sup>	<0.05	59.0 <sup>a</sup>	77.6 <sup>a</sup>	<0.01
30	68.8 <sup>a,b</sup>	78.8 <sup>a</sup>	<0.01	62.1 <sup>a</sup>	76.7 <sup>a</sup>	<0.01
60	66.5 <sup>b</sup>	74.0 <sup>b</sup>	<0.01	60.6 <sup>a</sup>	78.6 <sup>a</sup>	<0.01

<sup>a,b</sup>Means with a column for either grazed or non-grazed with unlike superscripts differ ( $P < 0.05$ ).

areas of the residue, throughout the grazing period leaf fractions had greater IVNDFD in BMR compared to CON ( $P < 0.01$ ). On average, there was an increase of 6%-12% units for IVNDFD for BMR compared to CON. However, the increase in IVNDFD was dependent upon whether the sample was from grazed or non-grazed areas and the length of grazing. Interestingly, IVNDFD was observed to decrease over time in the leaf fraction, regardless of treatment. The most notable decrease (8%-12% units) occurred in the grazed areas of the paddock over the entire grazing period, with most of decline occurring from day 30 to day 60 ( $P < 0.01$ ) in both BMR and CON. While there was an observed decrease in IVNDFD over the course of the grazing period for the non-grazed enclosures, the reduction was only observed to be 2%-4% units over time.

A large increase in IVNDFD in BMR compared to CON was observed for the stem fraction. Regardless of sample location, a 13%-19% unit increase for IVNDFD was observed for BMR compared to CON ( $P < 0.01$ ). Additionally, no difference was observed between IVNDFD for stems from grazed or non-grazed areas at day 4 or day 30 ( $P > 0.3$ ). While there was a difference in IVNDFD of stem fractions at day 60 for the BMR treatment between grazed and non-grazed areas ( $P < 0.01$ ), the difference is only

5% units. This observation suggests that grazing pressure does not markedly impact the digestibility of the stem fraction compared to the leaf fractions. However, because cattle tend to consume primarily the leaf fraction of the grain sorghum residue, the overall change in IVNDFD for stem fractions may be less important compared to the change in IVNDFD for the leaf fraction.

Perhaps the most interesting observation was that although there appeared to be a significant difference ( $P < 0.01$ ) in IVNDFD between the leaf and stem fractions of the CON treatment, IVNDFD was comparable between the leaf and stem fractions in the BMR hybrid ( $P > 0.05$ ). This suggests cattle could consume the stem residue of the *bmr*- grain sorghum hybrid and perform similar to grazing the leaf fractions, if stems are palatable.

Grazing grain sorghum residue containing the *bmr*-trait can provide an alternative method of backgrounding. Incorporating the *bmr*-trait does markedly improve NDF digestibility, which carried over to a positive gain response for grazing calves.

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