

Evaluating the Use of BMR Corn as an Acceptable Forage Source for Grazing Cattle

A.R. Williams, D.M. Staudenmeyer, R.L. Endecott, and E.C. Glunk

Department of Animal and Range Sciences, Montana State University, Bozeman, MT

IMPACT STATEMENT

This project will be useful in providing producers information on an alternative forage source for grazing cattle. Utilizing an alternative forage source can lengthen the grazing season, and help to improve cattle productivity while decreasing grazing impacts on native and introduced pastures.

SUMMARY

Montana is a typically low-rainfall area with limited irrigation in some areas. Moisture is critical for producing high-yielding, high-quality forages. Finding forage species that can produce both a high-quality and high-yielding product is important for livestock producers throughout Montana and the region. While quality of perennial and annual grasses may be comparable to corn, their yield per acre is significantly less.

Corn is commonly used in other parts of the country as a forage source, whether it be for grazing, hay, or silage. Therefore, the main objectives of this study were: to evaluate whether the improved BMR (Brown Midrib) corn varieties are an acceptable grazing source for livestock, identify any anti-quality factors that may be associated with BMR corn, and to identify the average nutrient values for the three varieties. We hypothesized that these improved BMR corn varieties would be an acceptable grazing source for livestock, and would be able to be utilized by producers as another forage option in their livestock management.

INTRODUCTION

Corn crop residues can be used as an economical and efficient feedstuff (Fernandez-Rivera and Klopfenstein, 1989). Grazing the stalks of corn residues is one of the most economical uses of the residue, allowing many of the nutrients to be recycled back into the soil (Klopfenstein et al., 1987; Lamm and Ward,

1981). In a beef cattle/forage system, utilizing the entire corn plant, rather than just the residue, can lower feed costs and reduce the overall amount of land that is needed, due to the high production of corn per acre (Ward, 1978). Grazing corn also provides a good source of feed during the winter. At the end of the forage growing season, corn is still highly available and an easily accessible cattle forage source (Gutierrez-Ornelas and Klopfenstein, 1991). Grazing corn throughout the winter generates acceptable weight gains, though the weight gains will be dependent on the severity of the winter. (Russell et al., 1993)

Corn hybrids have been utilized and selected for higher digestibility to help increase livestock gains. (Fernandez-Rivera et al., 1989) One of these hybrids is Brown Midrib (BMR) corn. These cultivars have reduced lignin content, a complex structural polymer which gives plants their rigidity and structure (Ioue et al., 1998; Guo et al., 2001a). The decreased lignin content typically leads to increases in *in vitro* digestibility, which helps reduce rumination requirements and increases overall plant digestibility, while increasing overall animal performance (Vanderwerff et al., 2015; Ferraretto and Shaver, 2014).

Livestock can have a greater dry matter and nutrient intake with the BMR variety, compared to other corn cultivars. (Ferraretto et al., 2014.) While research exists on effects of feeding BMR corn in ensiled and preserved forms, research is lacking in evaluating the use of BMR corn as a

grazing source. Therefore, the goal of this project was to evaluate the nutrient quality differences amongst three different BMR corn varieties, any anti-quality factors that may exist, and its overall suitability as a grazing source.

PROCEDURES

The study was a completely randomized block design, with three replications of each variety per block, and a total of three blocks. Each plot measured 80.5' x 30'. The target seeding rate for all three varieties was 50,000 plants per acre, or 1.15 plants/ square foot, a common planting rate for forage corn. Corn was planted on June 10, 2015. Corn was irrigated using a wheel-line for approximately one month, until the plants were too tall. Corn was then rain-fed for the remainder of the summer. The goal was to graze the corn at three different maturities: dent, soft dough, and ripening.

Once corn reached dent stage, corn was sampled for nitrates. Utilizing the Nitrate QuikTest, it was found that the corn had high levels of nitrates, and grazing was delayed. Nitrate levels were sampled with the QuikTest two weeks later, and still remained high so the grazing portion was eliminated from the study. Samples were sent to a commercial lab to quantitatively evaluate the nitrate levels. The remainder of the study was to evaluate corn forage quality and digestibility to evaluate nutrient suitability for grazing after plant senescence.

To determine forage yield, a single 1' x 1' square was clipped to 6" in height from each of the plots. All samples were weighed immediately after clipping to obtain a fresh, or wet weight. Samples were then placed in a 60° C forced air oven to estimate dry matter (DM). Samples were weighed daily until a consecutive weight was obtained two days in a row, indicating they were completely dry. Dry weights were then measured, and DM% was calculated using the equation:

$$DM\% = (\text{fresh weight} - \text{dry weight}) / \text{fresh weight}$$

After drying, samples were then ground through a 5mm screen initially, followed by grinding

through a 2 mm screen, randomizing equal portions of stems and leaves. Ground samples were then analyzed for acid detergent fiber (ADF), neutral detergent fiber (NDF), crude protein (CP), and *in situ* digestibility to determine neutral detergent fiber disappearance (NDFD).

RESULTS AND DISCUSSION

All three varieties had CP, ADF, and NDF concentrations that are similar to other forages utilized for livestock grazing (Table 1). The CP for all three varieties was higher than the values reported by Martin et al. (2008) who were evaluating the utility of corn silage.

There was a trend for an effect of variety ($P = 0.09$) on protein, and there was a significant effect of replication ($P = 0.003$) on protein values. The CP values indicate very high protein, similar in quality to a mixed grass and legume forage. These values are also higher than those reported in other studies (Kurt and Contach, 2014; Sheaffer et al. 2006), but are within acceptable limits. The CP levels obtained from these three varieties would be acceptable for cattle in many stages of production, including lactation and gestation (Lalman, 2000).

There was an effect of both variety ($P = 0.008$) and replication ($P < 0.001$) on NDF. NDF values were slightly greater than those reported by Kurt and Contach (2014) and Sheaffer et al. (2006), although it is likely due to the fact that our corn was harvested at a later stage of maturity than the previous research.

There was no effect of variety ($P = 0.20$) or replication ($P = 0.12$) on nitrate levels. All levels were considered safe for non-pregnant animals, although some of the samples were over 1,500 ppm NO₃, at which level producers are cautioned to limit-feed or dilute-feed those forages to pregnant animals.

There was no impact of variety on ADF ($P = 0.22$), however there was an effect of replication ($P < 0.001$). The ADF values are also slightly greater than those reported in other studies (Kung, et al., 2008), which again is likely a reflection of the late stage of maturity at harvest, rather than any effect of the corn varieties themselves.

The 48-h NDFD values (Table 2) are similar to those reported for ensiled BMR corn by Kurt and Cotanch (2014), but greater than those reported by Sheaffer et al. (2006). The numbers found suggest that the corn forage was highly digestible, and able to be utilized fairly rapidly by the rumen microbes. There were no differences observed ($P = 0.93$) between the varieties for any of the times sampled for NDFD. There were differences observed in NDFD amongst varieties ($P = 0.04$) and replication ($P = 0.005$). We also observed a trend for an effect of variety*replication ($P = 0.08$), with varieties 1 and 3 having higher NDFD in replication 3 than the other two replications.

It was interesting, and unexpected, to see an effect of replication on some of the quality parameters. The entire field was managed similarly in regards to fertilization and pesticide spraying. It is suspected that because replication 3 was on the side of the field closest to a water source, this may have had an impact on soil nutrient uptake. Preliminary nutrient studies in Montana have found that soil moisture plays a critical role in soil nutrient mobility and plant uptake (Sapkota, 2016).

This research suggests that BMR corn can be utilized as an acceptable grazing source for cattle. It should be noted that in the fall after completion of the research project, a small herd of pregnant cows was turned out onto the research plots, and grazed all plots without appearing to have any issues with palatability. Producers should be cautioned to pay attention to the possibility of nitrate toxicity when grazing corn, and testing is highly recommended.

REFERENCES

- Cheny, J., B. Cox, D. J. R. Cherney. 2001. Influence of brown midrib, leafy, and transgenic hybrids on corn forage production. *Agron J.* 93: 790-796.
- Cheny, J., B. Cox, D. J. R. Cherney. 2011. Feeding BMR corn silage. Cornell University Cooperative Extension. http://forages.org/files/gis/GIS33_Feeding_BMR_Corn_Silage.pdf.
- Ferraretto, L. F., A.C. Fonseca, C. J. Sniffen, A. Formigoni, and R. D. Shaver. 2014. Effect of corn silage hybrids differing in starch and neutral detergent fiber digestibility on lactation performance and total-tract nutrient digestibility by Dairy cows. *J. Dairy Sci.* 98: 395-405.
- Ferraretto, L. F., and R. D. Shaver. 2014. Effects of whole-plant corn silage hybrid type on intake, digestion, ruminal fermentation, and lactation performance by dairy cows through a meta-analysis. *J. Dairy Sci.* 98: 2661-2675.
- Fernandez-Rivera, S., M. Lewis, T. J. Klopfenstein, and T. L. Thompson. 1989. A simulation model of forage yield, quality and intake and growth of growing cattle grazing cornstalks. *J. Anim. Sci.* 67: 581-589.
- Fernandez-Rivera, S., and T. J. Klopfenstein. 1989a. Diet composition and daily gain of growing cattle grazing dryland and irrigated cornstalks at several stocking rates. *J. Anim. Sci.* 67:590-596.
- Fernandez-Rivera, S., and T. J. Klopfenstein. 1989b. Yield and quality components of corn crop residues and utilization of these residues by grazing cattle. *J. Anim. Sci.* 67: 597-605.
- Fernandez-Rivera, S., T. J. Klopfenstein, and R. A. Britton. 1989. Growth response to escape protein and forage intake by growing cattle grazing cornstalks. *J. Anim. Sci.* 67:574-580.
- Grant, R., K. Contanch. 2014. Researching the forage-cow interface at Miner Institute. UVM Extension Meeting. Chazy, NY.
- Gutierrez-Ornelas, E., and T. J. Klopfenstein. 1991. Changes in availability and nutritive value of different corn residue parts as affected by early and late grazing seasons. *J. Anim. Sci.* 69: 1741-1750.
- Klopfenstein, T., L. Roth, S. Fernandez-Rivera, and M. Lewis. 1987. Corn residues in beef

- production systems. *J. Anim. Sci.* 65: 1139-1148.
- Kung, L., B. M. Moulder, C. M. Mulrooney, R. S. Teller, R. J. Schmidt. 2008. The effect of silage cutting height on the nutritive value of a normal corn silage hybrid compared with brown midrib corn silage fed to lactating cows. *J. Dairy Sci.* 91: 1451-1457.
- Lalman, D. 2000. Nutrient requirements of beef cattle. OSU Cooperative Extension E-974.
- Lamm, W. D., and J. K. Ward. 1981. Compositional changes in corn crop residues grazed by gestating beef cows. *J. Anim. Sci.* 52(5): 954-958
- Russel, J. R., M. R. Brasche, and A. M. Cowen. 1993. Effects of grazing allowance and system on the use of corn-crop residues by gestating beef cows. *J. Anim. Sci.* 71: 1256-1265.
- Sheaffer, C.C., J.L. Halgerson, H. G. Jung. 2006. Hybrid and N fertilization affect corn silage yield and quality. *J. Agron and Crop Sci.* 192: 278-283.
- Vanderwerff, L. M., L. F. Ferraretto, and R. D. Shaver. 2015. Brown midrib corn shredlage in diets for high-producing dairy cows. *J. Dairy Sci.* 98: 5642-5652.
- Ward, J. K. 1978. Utilization of corn and grain sorghum residues in beef cow forage systems. *J. Anim Sci.* 46: 831-840.

ACKNOWLEDGEMENTS

We would like to thank Wilbur-Ellis for their contributions and participation in this research project, as well as Dr. Richard Waterman and the staff at USDA-ARS Ft. Keogh for their help and support.

Table 1. Nutrient analysis of three varieties of BMR corn.

Variety	CP%	ADF%	NDF%	Nitrate, ppm	48 h NDFD %
1	13.0 ^a	38.1	56.0 ^a	0.19	76.34
2	14.2 ^b	37.4	55.2 ^b	0.25	73.82
3	14.3 ^b	37.8	56.5 ^a	0.14	75.34

CP= crude protein, ADF= acid detergent fiber, NDF= neutral detergent fiber.

Variety 1= STP7897R, Variety 2= INT9301R, Variety 3= STP8380R. Columns with different superscripts are statistically different (P <0.05) from one another.

Table 2. NDFD (neutral detergent fiber digestibility) of three varieties of BMR corn.

Variety	24 h NDFD %	48 h NDFD %	96 h NDFD %
1	53.91	76.34	79.06
2	52.21	73.82	77.10
3	53.10	75.34	77.82

Variety 1= STP7897R, Variety 2= INT9301R, Variety 3= STP8380R.

Columns with different superscripts are statistically different (P <0.05) from one another.