Performance of Beef Cattle Housed in a Dry Lot or on Bale-grazed Pasture in Winter

Michael Undi, Kevin Sedivec and Stephanie Becker
North Dakota State University Central Grasslands Research Extension Center

Cows in North Dakota typically are overwintered in dry lots to which feed, water and bedding are delivered on a regular basis. This practice of keeping cows in dry lots contributes greatly to winter feed costs, which are the single highest annual cost in a beef cow-calf operation. Allowing beef cattle to harvest their own forage potentially can decrease costs by reducing the cost of feeding, labor, fuel, machinery maintenance and repair, and manure removal.

This study assesses the performance of beef cattle kept on pasture to bale graze or in dry lot pens during the winter in North Dakota. Results show that bale grazing may be a viable alternative to keeping cattle in dry lots in winter. Further, environmental conditions such as blizzards will not necessarily hinder bale grazing when proper precautions are taken to ensure that animals have access to water, feed and shelter.

Summary

The performance of beef cows managed in two overwintering environments, pasture or dry lot pens, was evaluated in a study conducted during four winters, from 2016 to 2019, at the Central Grasslands Research Extension Center, Streeter, N.D. Keeping cows on pasture or in dry lot pens did not influence ($P > 0.05$) final body weight (BW) or body condition score (BCS).

However, daily gains and BCS change were greater ($P < 0.05$) in bale-grazed cows relative to cows kept in dry lot pens. Performance of calves from cows kept in the two overwintering environments was similar. Results show that bale grazing is a viable alternative to keeping cattle in dry lots in winter.

Introduction

The majority of beef cows in the northern Plains are housed in open dry lot pens in the winter (Asem-Hiablie *et al.,* 2016) and are exposed to extreme winter conditions. Winters in the northern Plains are characterized by cold temperatures, low wind chills, freezing rain and snow.

A large portion of winter (40 to 70 days) averages minus 18 C, although the extreme minimum temperature of minus 51 C has been recorded (Enz, 2003).

In typical dry lots, cattle are fed mechanically harvested feeds. Winter feed costs, resulting from labor, machinery and energy required to provide feed, water and bedding to cattle kept in dry lots, make up more than 60% of total feed costs for most beef

cow-calf operations (Taylor and Field, 1995). Thus, beef producers are interested in reducing winter feed costs by extending the grazing season.

Extending the grazing season by keeping cattle on pasture for a significant period of time in winter allows animals to harvest their own food and decreases reliance on inputs such as machinery required to harvest forage (D'Souza *et al.,* 1990). By maximizing the use of grazed grass, the cheapest feed resource for ruminants (Hennessy and Kennedy, 2009), extending the grazing season can decrease production costs and enhance profitability of livestock production (D'Souza *et al.,* 1990; Hennessy and Kennedy, 2009).

Strategies for extending the grazing season such as bale grazing, swath grazing and stockpiling have been evaluated (D'Souza *et al.,* 1990; Willms *et al.,* 1993; Volesky *et al.,* 2002; McCartney *et al.,* 2004; Jungnitsch *et al.,* 2011; Kelln *et al.,* 2011; Baron *et al.,* 2014). The economic benefits from these strategies accrue mainly from cost reductions of feeds and feeding, labor, fuel, machinery maintenance and repair, and manure removal.

Environmentally, keeping cattle on pasture returns nutrients directly onto the land and allows for optimal nutrient capture by growing plants (Jungnitsch *et al.,* 2011; Kelln *et al.,* 2011). Depositing manure directly on pastures avoids nutrient accumulation in one place, minimizing nutrient loss to the environment through runoff or leaching (Kelln *et al.,* 2012; Bernier *et al.,* 2014).

Extending the grazing season must be assessed against benefits to the animal as well as to the producer. Local information on animal performance in extended grazing systems, especially bale grazing, as well as data on the economics of extended grazing under North Dakota winter conditions, is limited. Therefore, this study was conducted to assess the performance of beef cows managed in two overwintering environments (pasture or dry lot) under south-central North Dakota winter conditions.

Procedures

This study extended for four years, from 2016 to 2019. The study was conducted with nonlactating pregnant Angus cows (2016, n = 32, body weight [BW] = 599 ± 68 kilograms [kg]; 2017, n = 40, BW = 620 ± 59 kg; 2018, n = 40, BW = 643 ± 47; 2019, n = 40, BW = 624 ± 30).

Starting in the fall of each year, cows were divided into four groups of similar body weight and randomly assigned to bale-grazing paddocks or dry lot pens. Cow performance was assessed using body weight changes and body condition scores (BCS). Two-day body weights were taken at the start and end of the study.

Two independent observers assigned BCS using a 9-point system (1 = emaciated, 9 = obese; Wagner *et al*., 1988; Rasby *et al*., 2014) at the start and end of each season. Calf performance was assessed from birth weights and weaning weights. Animal handling and care procedures were approved by the NDSU Animal Care and Use Committee.

Bale Grazing

Two 1.3-hectare (ha) paddocks separated by three-strand, high-tensile wire electric fencing were used for bale grazing. A water tank installed between the paddocks supplied water. Each paddock had windbreaks.

In early fall of each year, 40 round grass hay bales were placed in each paddock with two bales to a row. Net wrap was removed prior to feeding. Cows were allotted four bales at a time, and access to new bales was controlled using one portable electric wire. Cows were offered a salt block and mineral supplement, and had *ad libitum* access to water.

Dry Lot

Two dry lot pens were used for this study. Each pen contained a hay feeder and a winterized water bowl (Richie Industries Inc., Conrad, Iowa). Dry lot cows were fed the same grass hay as the bale-grazed cows. Like the bale grazed cows, dry lot cows had *ad libitum* access to fresh water, mineral supplement and salt blocks.

Results and Discussion

Temperatures during the study are shown in Figure 1. Mean monthly temperatures of minus 14 C and minus 21 C in December and January of 2016-2017 were below normal and lower, compared with other years. Normal temperatures for this time of year are minus 10 C and minus 13 C for December and January, respectively. Temperatures in the winter of 2018-2019 were higher than normal for the same period, averaging minus 7 C for December and January (Figure 1).

December 2016 and December 2019 were marked by extremely heavy snowfall (Figure 2), with monthly snowfall totals in 2016 and 2019 of 81 and 90 centimeters, respectively. These two years also were marked by several blizzards, three in 2016 and two in 2019, during the bale grazing season.

Overwintering housing systems in this study were evaluated in a four-year period that had variable environmental conditions. Indeed, environmental conditions differed greatly on an annual basis.

The first year of bale grazing, 2016, had the lowest December and January temperatures. Temperatures for the remaining three grazing years were comparable.

Precipitation also differed significantly among bale grazing years. The 2016 and 2019 bale grazing seasons were marked by stormy weather, with three blizzards occurring in 2016 and two in 2019. Despite heavy snow accumulation in bale-grazed paddocks following these weather events, cows were able to bale graze to the end of the bale grazing period in each grazing year.

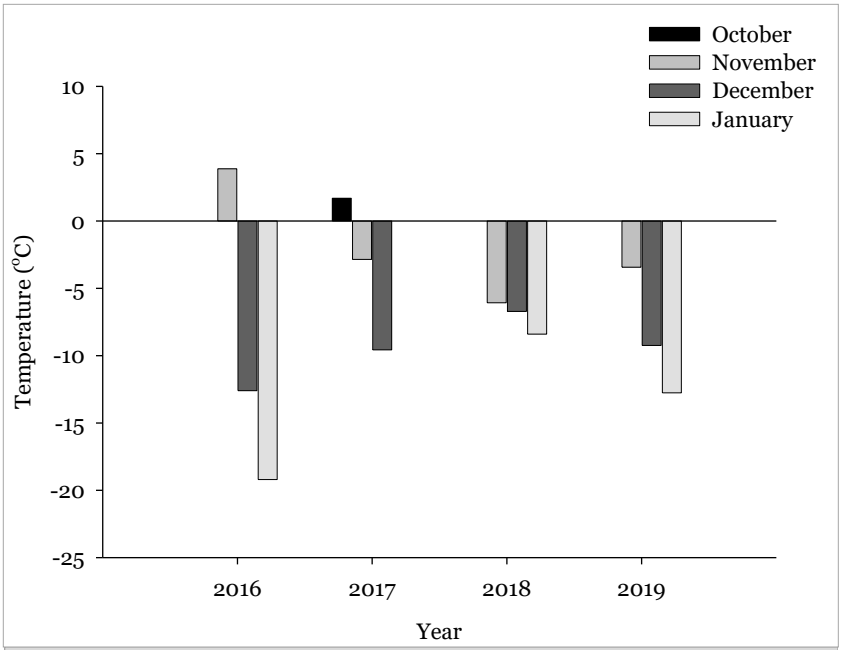

Figure 1. Average temperatures during bale grazing. Bale grazing dates were Nov. 4, 2016, to Jan. 12, 2017; Oct. 24 to Dec. 28, 2017; Nov. 17, 2018, to Jan. 10, 2019; Nov. 14, 2019, to Jan. 17, 2020. Data from North Dakota Agricultural Weather Network (2020).

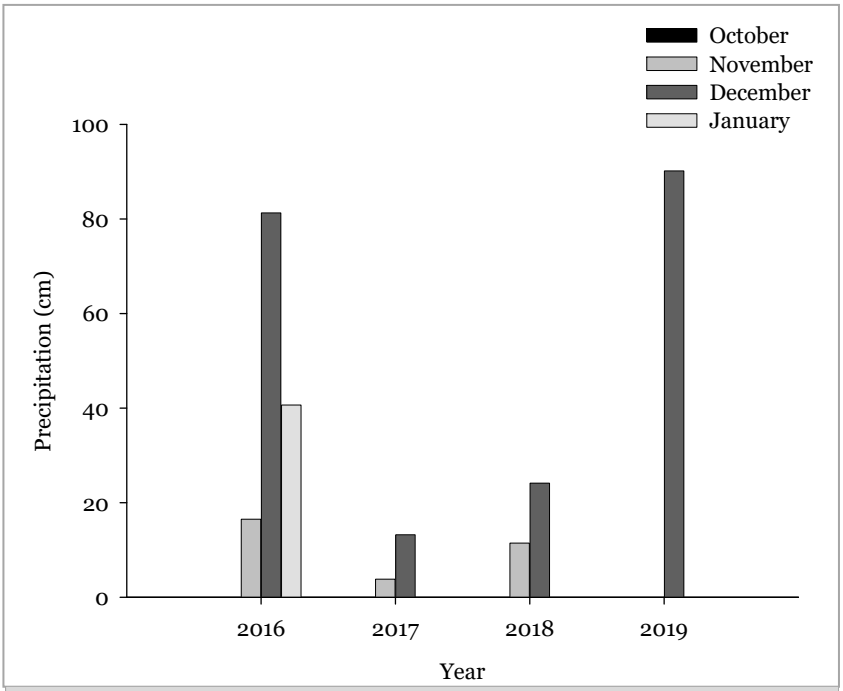

Figure 2. Snowfall (in cm) during bale grazing. Bale grazing dates were Nov. 4, 2016, to Jan. 12, 2017; Oct. 24 to Dec. 28, 2017; Nov. 17, 2018, to Jan. 10, 2019; Nov. 14, 2019, to Jan. 17, 2020. Data from National Oceanic and Atmospheric Administration (NOAA).

Table 1. Nutrient composition (mean ± SD; percent dry-matter [DM] basis) of grass hay offered to cows bale grazing on pasture or kept in a dry lot.

Nutrient	Percent DM
Crude protein	7.9 ± 0.51
Total digestible nutrients	55.1 ± 0.45
Neutral detergent fiber	66.3 ± 0.69
Acid detergent fiber	47.3 ± 1.96
Calcium	0.61 ± 0.04
Phosphorus	0.11 ± 0.04

The challenge after storms was keeping water accessible to cows on pasture. In the first year of this study, the third blizzard made keeping water points open impossible to do and led to the termination of the study. This study shows that strategies for extending the grazing season should be accompanied by a contingency plan for feed and water supplies in case grazing becomes impossible.

We noted some interesting observations from blizzard events of 2016 and 2019 for bale-grazing cows on pasture. First, despite windbreaks, not all cows sought shelter during blizzards. Some cows simply would stand on the leeward side of hay bales, while others did not seek shelter at all and continued to graze.

Secondly, when water troughs were cleared of snow and refilled after each blizzard, not all cows visited water troughs immediately. However, we observed what seemed to be a "catch up" period of several days following blizzards when water intake increased, as noted by more frequent filling of water troughs.

Events such as blizzards can prevent or drastically reduce access to water, requiring pastured cows to utilize snow as a source of water. Animals can survive on snow as shown in beef calves (Degen and Young, 1990a) and pregnant beef cows (Degen and Young, 1990b).

Grass Hay

Nutrient composition of grass hay that was bale grazed and fed in dry lot in the four grazing seasons is shown in Table 1. Grass hay averaged 7.9% crude protein (CP) and a total digestible nutrient (TDN) content of 55.1%.

Cow Performance

Initial cow BW were similar ($P > 0.05$) between housing treatments (Table 2). Similarly, keeping cows on pasture or in dry lot pens in winter did not influence ($P > 0.05$) final BW. However, daily gains were greater ($P < 0.05$) in bale-grazed cows relative to cows kept in dry lot pens. Differences in daily gains could be due to differences in forage between bale-grazed cows and cows kept in dry lot pens.

Initial and final BCS were not influenced ($P > 0.05$) by type of overwintering system (Table 2). Although both groups lost body condition during winter, BCS change was greater ($P < 0.05$) in cows kept in dry lot pens relative to bale-grazed pasture (Table 2).

Table 2. Performance of cows kept on pasture or in a dry lot in winter.

	Housing			Year				
	Pasture	Dry lot	SE	2016	2017	2018	2019	SE
Initial BW, kg	621	624	9.5	599^{c}	615^{bc}	646^{a}	630^{ab}	9.6
Final BW, kg	625	618	9.1	577^{b}	635^{a}	651^{a}	623^{a}	11.5
Daily gain, kg/d	0.07^{a}	-0.08^{b}	0.05	-0.33^{c}	0.24^{a}	0.10^{ab}	-0.03^{b}	0.07
Initial BCS	5.8	5.9	0.05	5.7^{b}	5.4^{c}	5.8^{b}	6.5^{a}	0.06
Final BCS	5.7	5.7	0.06	5.4^{b}	5.4^{b}	5.2^{c}	6.7^{a}	0.07
BCS change	-0.08^{a}	-0.21^{b}	0.04	-0.25^{b}	0.05^{a}	-0.57^{c}	0.20^{a}	0.06

Means with a different letter within a row for housing and within row for year differ significantly ($P \leq 0.05$).

Table 3. Performance of calves from cows kept on pasture or in a dry lot in winter.

	Housing			Year				
Heifer calves	**Pasture**	**Dry lot**	**SE**	**2016[1]**	**2017**	**2018**	**2019**	**SE**
Birth weight, kg	37	38	1.3	36	37	38	38	1.8
Age at weaning, days	186	186	3.1	173[b]	174[b]	203[a]	193[a]	5.2
Weaning weight, kg	255	247	7.8	237[b]	236[b]	258[a]	273[a]	10.9
205-d weaning wt, kg	276	268	6.6	280[a]	260[b]	260[b]	288[a]	9.3
ADG, kg/day	1.2	1.1	0.03	1.2[ab]	1.1[b]	1.1[b]	1.2[a]	0.04
Bull calves								
Birth weight, kg	40	41	1.4	39	41	40	44	2.0
Age at weaning, days	186	186	3.3	173[b]	176[b]	207[a]	188[a]	4.4
Weaning weight, kg	272	273	7.4	249[b]	244[b]	293[a]	303[a]	10.5
205-d weaning wt, kg	294	297	6.9	288[b]	277[b]	291[b]	327[a]	9.8
ADG, kg/day	1.2	1.3	0.03	1.2[a]	1.2[a]	1.2[b]	1.4[a]	0.05

[1]Calves were born in 2017, 2018, 2019 and 2020 following bale grazing in 2016, 2017, 2018 and 2019, respectively.
Means with a different letter within a row for housing and within a row for year differ significantly ($P \leq 0.05$).

Calf Performance

Bull calf birth weights, weaning weights and daily gains were not influenced ($P > 0.05$) by type of housing (Table 3). As well, heifer calf birth weights and weaning weights were not influenced ($P > 0.05$) by type of housing. However, heifer calf daily gains tended ($P < 0.10$) to be greater in calves from bale-grazed cows (Table 3).

Conclusions

Results show that bale grazing is a viable alternative to keeping cattle in dry lots in the winter. Further, environmental conditions such as blizzards will not necessarily hinder bale grazing when proper precautions are taken to ensure that animals have access to water, feed and shelter.

Acknowledgments

The excellent technical assistance provided by the late Rodney Schmidt and the late Dwight Schmidt, as well as Scott Alm, Tim Long, Cody Wieland, Thomas Mittleider and Rick Bohn is gratefully acknowledged.

Literature Cited

Asem-Hiablie, S., Rotz, C.A, Stout, R., and Stackhouse-Lawson, K. 2016. Management characteristics of beef cattle production in the Northern Plains and Midwest regions of the United States. Prof. Anim. Sci. 32: 736-749. http://dx.doi.org/10.15232/pas.2016-01539.

Baron, V.S., Doce, R.R., Basarab, J., and Dick, C. 2014. Swath-grazing triticale and corn compared to barley and a traditional winter feeding method in central Alberta. Can. J. Plant Sci. 94: 1125-1137.

Bernier, J.N., Undi, M., Ominski, K.H., Donohoe, G., Tenuta, M., Flaten, D., Plaizier, J. C., and Wittenberg, K.M. 2014. Nitrogen and phosphorus utilization and excretion by beef cows fed a low quality forage diet supplemented with dried distillers' grains with solubles under thermal neutral and prolonged cold conditions. Anim. Feed Sci. & Technol. 193: 9-20.

Degen, A.A., and Young, B.A. 1990a. Average daily gain and water intake in growing beef calves offered snow as a water source. Can. J. Anim. Sci. 70: 711-714.

Degen, A.A., and Young, B.A. 1990b. The performance of pregnant beef cows relying on snow as a water source. Can. J. Anim. Sci. 70: 507-515.

D'Souza, G.E., Marshall, E.W., Bryan, W.B., and Prigge, E.C. 1990. Economics of extended grazing systems. Am. J. Alternative Agric. 5 (3): 120–125.

Enz, J.W. 2003. North Dakota topographic, climatic, and agricultural overview. www.ndsu.edu/fileadmin/ndsco/documents/ndclimate.pdf

Hennessy, D., and Kennedy, E. 2009. Extending the grazing season. Livestock. 14: 27-31. doi: 10.1111/j.2044-3870.2009.tb00233.x

Jungnitsch, P., Schoenau, J.J., Lardner, H.A., and Jefferson, P.G. 2011. Winter feeding beef cattle on the western Canadian prairies: impacts on soil nitrogen and phosphorous cycling and forage growth. Agric. Ecosyst. Environ. 141: 143-152.

Kelln, B.M., Lardner, H.A., McKinnon, J.J., Campbell, J.R., Larson, K., and Damiran, D. 2011. Effect of winter feeding system on beef cow performance, reproductive efficiency, and system cost. Prof. Anim. Sci. 27: 410-421.

Kelln, B., Lardner, H., Schoenau, J., and King, T. 2012. Effects of beef cow winter feeding systems, pen manure and compost on soil nitrogen and phosphorous amounts and distribution, soil density, and crop biomass. Nutr. Cycl. Agroecosyst. 92: 183–194.

McCartney, D., Basarab, J.A., Okine, E.K., Baron, V.S., and Depalme, A.J. 2004. Alternative fall and winter feeding systems for spring calving beef cows. Can. J. Anim. Sci. 84: 511-522.

Osuji, P.O. 1974. The physiology of eating and the energy expenditure of the ruminant at pasture. J. Range Manage. 27 (6): 437-443.

Rasby, R.J., Stalker, A., and Funston, R.N. 2014 Body condition scoring beef cows: A tool for managing the nutrition program for beef herds. University of Nebraska –Lincoln Extension. http://extensionpublications.unl.edu/assets/pdf/ec281.pdf

Taylor, R.E., and Field, T.G. 1995. Achieving cow/calf profitability through low cost production. Range Beef Cow Symposium. University of Nebraska, Lincoln. http://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1198&context=rangebeefcowsymp

Volesky, J.D., Adams, D.C., and Clark, R.T. 2002. Windrow grazing and baled-hay feeding strategies for wintering calves. J. Range Manage. 55: 23-32.

Wagner, J.J., Lusby, K.S., Oltjen, J.W., Rakestraw, J., Wetteman, R.P., and Walters. L.E. 1988. Carcass composition in mature Hereford cows: Estimation and effect on daily metabolizable energy requirement during winter. J. Anim. Sci. 66:603-612.

Willms, W.D., Rode, L.M., and Freeze, B.S. 1993. Winter performance of Hereford cows on fescue prairie and in drylot as influenced by fall grazing. Can. J. Anim. Sci. 73:881-889.

Photos by Michael Undi, NDSU