Performance of Beef Cattle Overwintered on Bale-grazed Pasture or in a Dry Lot in South-central North Dakota

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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 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) and 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 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 -18 °C, although the extreme minimum temperature of -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). Maximizing the use of grazed grass, the cheapest feed resource for ruminants (Hennessy and Kennedy, 2009), by 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. 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 non-lactating pregnant Angus cows (2016, n = 32, BW = 599 ± 68 kilograms [kg]; 2017, n = 40, BW = 620 ± 59 kg; 2018, n = 40, BW = 643 ± 47 kg; 2019, n = 40, BW = 624 ± 30 kg). Starting in the fall of each year, cows were divided into four groups of similar body weight and assigned randomly to bale grazing paddocks or dry-lot pens. Cow performance was assessed using BW changes and 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 that were 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 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

Temperatures during the study are shown in Figure 1. Mean monthly temperatures of -14°C and -21°C in December and January 2016-2017 were below normal and lower, compared with other years. Normal temperatures for this time of year are -10°C and -13°C for December and January, respectively. Temperatures in the winter of 2018-2019 were higher than normal for the same period, averaging -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 of 81 and 90 centimeters (cm), respectively, in 2016 and 2019. These two years also were marked by several blizzards: three in 2016 and two in 2019 during the bale-grazing season. The lowest precipitation occurred in December and January 2017-2018, with an average of 13 cm in both months (Figure 2).

Grass Hay Nutritive Value
Nutrient composition of grass hay that was bale grazed and fed in dry lots in the four grazing seasons is shown in Table 1. Grass hay averaged 7.9% crude protein (CP), with a range of 7.6% to 8.8%, and a total digestible nutrient (TDN) content of 55.1%, with a range of 54% to 55.9%.

Cow Performance
Initial cow body weights 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. Overall, cows kept in dry-lot pens lost weight each of the four years. 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).

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).

Discussion

Overwintering housing systems in this study were evaluated in a four-year period that had variable environmental conditions. Temperature during bale grazing were lowest in December and January of the first year of bale grazing, 2016, and mildest in 2018. Temperatures in 2017 and 2019 were intermediate and 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.

The challenge after storms was keeping water accessible to cows on pasture. In the first year of bale grazing, the third blizzard made keeping water points open impossible and led to termination of the study. 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.

Average daily gains were greater in bale-grazed pasture relative to cows kept in dry-lot pens. A possibility for differences in daily gains could be stress related to changes in the environment associated with moving cows to dry lots. Both groups of cows were kept on pasture from mid-May to the start of the study. Bale grazing cows were kept in familiar surroundings and continued to graze at their own pace with more room to walk around. Cows kept in dry-lot pens did not have the same opportunity.

In terms of energy expenditure, the smaller-size dry-lot pens would be expected to give dry-lot cows a competitive energy expenditure advantage because these cows would not have to spend much energy walking. Animals on pasture spend more energy walking in search of food and water or shelter and more time eating and foraging for food than housed animals (Osuji, 1974). Extra muscular activities, over and above those observed indoors, might increase maintenance energy requirements of animals on range by 25% to 50% (Osuji, 1974). However, this might not apply in this situation because bale grazing cows did not have to forage long distances.

Keeping cattle on pasture or in dry-lot pens in winter must be assessed against benefits to the animal, as well as financial benefits to the producer. Extending the grazing season reduces feed costs significantly because animals harvest their own food (D'Souza et al., 1990). Several studies (D'Souza *et al.,* 1990; Willms *et al.,* 1993; McCartney *et al.,* 2004; Jungnitsch *et al.,* 2011; Kelln *et al.,* 2011; Baron *et al.,* 2014) have shown economic advantages of extending the grazing season associated with reducing costs of feeds and feeding, labor, fuel, machinery maintenance and repair, and manure removal.

Conclusions

Results show that bale grazing is 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.

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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	**% 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

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

	Housing (H)			Year (Y)					*P*-value		
	Pasture	Dry lot	SE	2016	2017	2018	2019	SE	H	Y	H x Y
Initial BW, kg	621	624	9.5	599[c]	615[bc]	646[a]	630[ab]	9.6	0.809	0.001	0.079
Final BW, kg	625	618	9.1	577[b]	635[a]	651[a]	623[a]	11.5	0.491	<0.001	0.676
Daily gain, kg/day	0.07[a]	-0.08[b]	0.05	-0.33[c]	0.24[a]	0.10[ab]	-0.03[b]	0.07	0.007	<0.001	0.296
Initial BCS	5.8	5.9	0.05	5.7[b]	5.4[c]	5.8[b]	6.5[a]	0.06	0.111	<0.001	0.836
Final BCS	5.7	5.7	0.06	5.4[b]	5.4[b]	5.2[c]	6.7[a]	0.07	0.253	<0.001	0.149
BCS change	-0.08[a]	-0.21[b]	0.04	-0.25[b]	0.05[a]	-0.57[c]	0.20[a]	0.06	0.003	<0.001	0.439

Means with a different letter within 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 (H)			Year (Y)				P-value		
	Pasture	Dry lot	SE	2017	2018	2019	SE	H	Y	H x Y
Heifers										
Birth weight, kg	37	37	1.6	36	37	38	2.0	0.670	0.344	0.194
Weaning weight, kg	248	238	10.0	237	236	258	12.3	0.333	0.094	0.934
Adjusted weaning weight, kg	278	263	9.1	280	271	260	11.2	0.106	0.174	0.779
ADG, kg/day	1.18	1.09	0.04	1.19	1.14	1.09	0.05	0.073	0.086	0.737
Bulls										
Birth weight, kg	40	40	1.7	39	41	40	2.0	0.993	0.547	0.801
Weaning weight, kg	260	265	8.7	249[b]	244[b]	293[a]	10.6	0.578	<0.001	0.586
Adjusted weaning weight, kg	283	287	8.2	288	277	291	10.0	0.668	0.358	0.894
ADG, kg/day	1.20	1.20	0.04	1.21	1.15	1.22	0.04	0.664	0.270	0.831

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

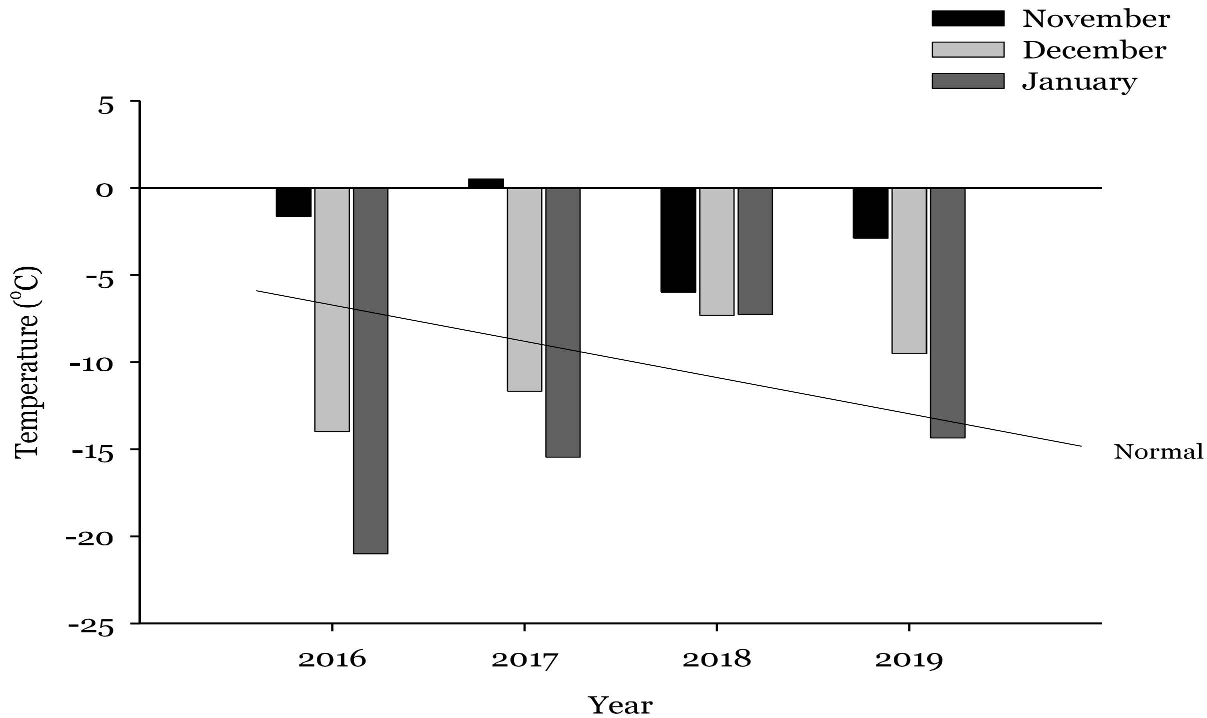

Figure 1. Monthly temperatures during bale grazing. November temperatures are for the last two weeks of the month and January temperatures are for the first two weeks. Data from North Dakota Agricultural Weather Network.

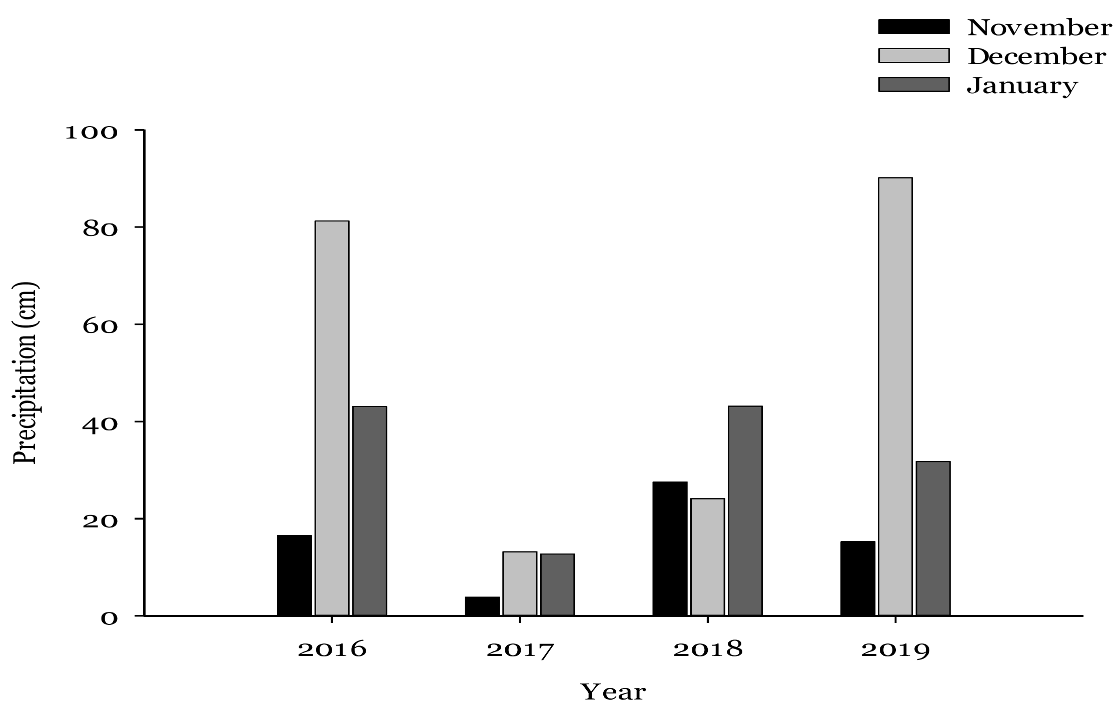

Figure 2. Precipitation during bale grazing. November precipitation is for the last two weeks of the month and January precipitation is for the first two weeks. Data from National Oceanic and Atmospheric Administration (NOAA).