Evaluation of Supplementation Strategies for Beef Cattle Bale Grazing Grass Hay in Winter

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The high cost of winter feeding, accounting for more than 60% of the total annual feed costs of a beef cow-calf operation, is associated with keeping cows in dry lots. Extending the grazing season through strategies such as bale grazing will reduce the cost of feeding, labor, fuel, machinery maintenance and repair, and manure removal.

When bale grazing, producers must ensure that animals have adequate nutrition. In line in with bale grazing, supplementation strategies that minimize or eliminate pasture visits will further the goal of minimizing winter feed costs.

This study examines strategies for supplementing cows that are bale grazing grass hay. Strategies evaluated include feeding grass hay in combination with alfalfa hay, a liquid supplement or corn dried distillers' grains with solubles (DDGS). Results suggest that supplementation with good-quality alfalfa hay or a liquid supplement is not adequate in severely cold winters. Under such conditions, high-energy supplements such as DDGS will be required to meet the nutrient shortfall.

Summary

Methods of supplementing beef cows that are bale grazing grass hay were investigated in a study conducted for four winters, from 2016 to 2019, at the Central Grasslands Research Extension Center, Streeter, N.D. Methods evaluated were a) grass hay supplemented with good-quality alfalfa hay, b) grass hay supplemented with corn DDGS and c) grass hay treated with a liquid supplement. Results show that the optimal method of supplementation depends on environmental conditions during winter. In severely cold winters, good-quality alfalfa hay or a liquid supplement are not adequate to meet the requirements of pregnant beef cows in early to mid-gestation. Under such conditions, supplements such as corn DDGS will be needed to meet animal requirements. Supplementation with good-quality alfalfa hay or grass hay treated with a liquid supplement may be an option during mild winters.

Introduction

Beef cattle in the northern Plains typically graze poor-quality forages in winter (Marshall et al., 2013). Poor-quality forages are generally low in energy, protein and minerals, impairing rumen microbial function, which leads to poor forage intake and digestion (Köster et al., 1996). The utilization of poor-quality forages can be improved through supplementation, which is especially important at critical times such as summer plant dormancy or fall and winter months (Caton and Dhuyvetter, 1997).

Cost-effective supplement delivery methods minimize feed costs by reducing supplement delivery frequency (Schauer et al., 2005; Canesin et al., 2014; Gross et al., 2016) or eliminating pasture visits (Klopfenstein and

Owen, 1981). Supplementation strategies that minimize or eliminate pasture visits in extended grazing systems will further the goal of minimizing winter feed costs. This study was conducted to investigate strategies for supplementing cows bale grazing grass hay in winter. The study examined beef cow performance and the cost effectiveness of bale grazing supplementation strategies.

Procedures

This study was conducted for four years, from 2016 to 2019, at the Central Grasslands Research Extension Center, Streeter, N.D. The bale grazing site was a 10.5-hectare (ha) field that historically was cropland, using a corn and small-grain rotation. In the two years prior to the commencement of this study, the site was planted to cool-season cover crops, mainly annual rye grass and brassicas. The site was sprayed with 2,4-D and glyphosate in late April 2016 and seeded to a meadow brome grass, which was planted in early May 2016.

The site was divided into eight 1.3-ha paddocks, which were separated using three-strand, high-tensile wire electric fencing. One water tank was installed between two paddocks to supply water to two groups of cows. Windbreaks were placed in each paddock. In the fall of each year, 40 hay bales were placed in each paddock, with two bales to a row. Net wrap was removed prior to feeding.

The study was conducted with non-lactating pregnant Angus cows (2016, n = 64, body weight [BW] = 595 ± 65 kilograms [kg]; 2017, n = 80, BW = 621 ± 59 kg; 2018, n = 80, BW = 643 ± 45 kg; 2019, n = 80, BW = 624 ± 33 kg). Starting in the fall of each year, cows were divided into eight groups of similar total body weight and assigned randomly to four bale grazing treatments.

The bale grazing treatments were as follows: a) grass hay (control), b) grass hay supplemented with alfalfa hay, c) grass hay supplemented with corn DDGS and d) grass hay treated with a liquid supplement. Bale grazing grass hay was expected to maintain body condition with no weight gains. Some weight and BCS changes were expected from supplemented diets. Most of the grass hay was obtained from a Conservation Reserve Program (CRP) field of mixed cool-season grasses that had not been harvested for several years.

Cows supplemented with DDGS were fed 1.8 kg of DDGS/head/day twice weekly. For alfalfa supplementation, one bale of alfalfa hay was fed for every three bales of grass hay. Liquid supplementation involved pouring approximately 34 liters of liquid supplement (Quality Liquid Feeds Inc.) onto grass hay bales. This amount of liquid supplement was calculated to increase hay protein content by approximately 3 percentage points.

In each treatment, cows were allotted four bales at a time, and access to new bales was controlled using one portable electric wire. Cows were moved to a new set of bales when remaining feed was deemed insufficient. Cows had *ad libitum* access to water and a salt block.

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. Body condition scores were assigned by two observers using a 9-point system (1 = emaciated, 9 = obese; Wagner et al., 1988; Rasby et al., 2014) at the start and end of each grazing period. Calf performance was assessed through birth weights and weaning weights. Animal handling and care procedures were approved by the NDSU Animal Care and Use Committee.

Results

Temperatures during bale grazing 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 precipitation totals of 81 and 90 centimeters (cm), respectively. 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).

Forage Nutritive Value

Nutrient composition of grass hay and grass hay supplemented with alfalfa hay, a liquid supplement or DDGS 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%. The addition of a liquid supplement increased the CP of grass hay to 9%, with a range of 8.7% to 9.7%. Liquid supplementation did not increase TDN content, which averaged 54.7%, with a range of 53.9% to 55.4% (Table 1). Supplementation with alfalfa hay increased the diet CP content to 10.8% CP, with a range of 10.1% to 11.8%, and TDN content to 56.3%, with a range of 54.4% to 57.1%. The highest increase occurred with DDGS supplementation, increasing CP content to 11.5% (10.8% to 12.2%) and TDN content to 58.3%, with a range of 57.3% to 59.1% (Table 1).

Cow Performance

Initial cow BW were similar ($P > 0.05$) among treatments but differed on a yearly basis (Table 2). Final BW were greater ($P < 0.05$) when cows were supplemented with DDGS and least when cows were not supplemented (Table 2). The diet by year interaction ($P = 0.025$) for daily gain showed that response to supplementation was dependent on the type of supplement as well as bale grazing season. In the 2016 bale grazing season, only supplementation with DDGS resulted in positive daily gains. Unsupplemented cows and cows supplemented with alfalfa and a liquid supplement lost weight during this grazing season (Figure 3). In 2017, daily gains were positive on all diets but lowest when unsupplemented grass hay was bale grazed. As in the 2016 grazing season, supplementation with DDGS resulted in greater daily gains in the 2018 and 2019 bale grazing seasons relative to other supplementation strategies (Figure 3).

Initial cow BCS were similar ($P > 0.05$) among treatments but differed on a yearly basis (Table 2). Final BCS were greatest ($P < 0.05$) when cows were supplemented with DDGS, intermediate following alfalfa or liquid supplementation and lowest in unsupplemented cows (Table 2). As well, final BCS differed ($P < 0.05$) on a yearly basis. The change in BCS was greatest in DDGS-supplemented cows and unsupplemented cows.

Calf Performance
Calf birth weights, weaning weights and daily gains were not influenced ($P > 0.05$) by method of supplementation (Table 3). Calf weaning weights and daily gains differed ($P < 0.05$) on a yearly basis. Calf performance was similar for bull and heifer calves (Table 3).

Discussion

The length of the bale grazing period in each year of this study was approximately 60 days, and efforts were made to ensure that the grazing period was similar across the years. As well, the study was conducted during the same period of the year, starting in mid-November and continuing into January. Evaluating supplementation strategies during bale grazing during a four-year period for the same length of study and at approximately the same time of year allowed us to relate animal response to supplementation under varying 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 among bale grazing years. The 2016 and 2019 bale grazing seasons were marked by stormy weather, with three blizzards occurring 2016 and two in 2019. Despite heavy snow accumulation in paddocks following these weather events, cows were able to bale graze to the end of the bale grazing period in each grazing year.

The initial expectation was that grass hay would supply the required TDN and CP to maintain cow body condition and BW during bale grazing. Evaluation of the supplementation strategies using the CowBytes Program (CowBytes Beef Ration Balancing Program; Version 4, Alberta Agriculture, Food and Rural Development, Alberta, Canada) showed that the diets provided variable amounts of CP and TDN and that grass hay and liquid supplementation did not supply adequate amounts of CP and TDN to meet nutritional requirement of cows in early to mid-gestation. Grass hay provided approximately 94% of the required CP and 86% of the required TDN. Similarly, liquid supplementation provided approximately 106% of the required CP but only 84% of the required TDN. Supplementation with alfalfa hay increased diet CP and TDN and supplied approximately 126% and 98% of the required CP and TDN, respectively. The highest increase in diet CP and TDN occurred with DDGS supplementation, which supplied approximately 143% and 105% of the required CP and TDN, respectively.

Supplementation of grass hay increased final BW, BCS and change in BCS, with the greatest increase occurring following DDGS supplementation. Trends in daily gains were influenced by type of supplement used as well as environmental conditions. The 2016 bale grazing season was particularly cold relative to other grazing seasons. Unsupplemented cows and cows supplemented with alfalfa or a liquid supplement lost weight. Only supplementation with DDGS resulted in positive daily gains. Response to supplementation in the last three grazing seasons differed in degree but not trend, with supplementation showing positive daily gains. Grass hay resulted in the lowest daily gains, and supplementation with DDGS resulted in greater daily gains relative to other supplementation strategies. Clearly, below-average temperatures and stormy weather made 2016 a unique year, when compared with the other grazing seasons.

This study shows that environmental conditions will play a part in determining the success of supplementing cows that are bale grazing grass hay in the winter. When winters were harsh, as occurred in 2016, grass hay did not contain adequate energy and protein to meet nutritional requirement of cows in early to mid-gestation. During the 2016 winter, supplementation of grass hay with good-quality alfalfa hay or a liquid supplement did not provide nutrients to meet the nutritional requirement of cows in early to mid-gestation. Supplementation with alfalfa and a liquid supplement was successful only under more moderate environmental conditions. Supplementation with DDGS was successful in maintaining and improving cow performance under different environmental conditions. Despite differences in cow performance, supplementation strategies did not influence calf performance.

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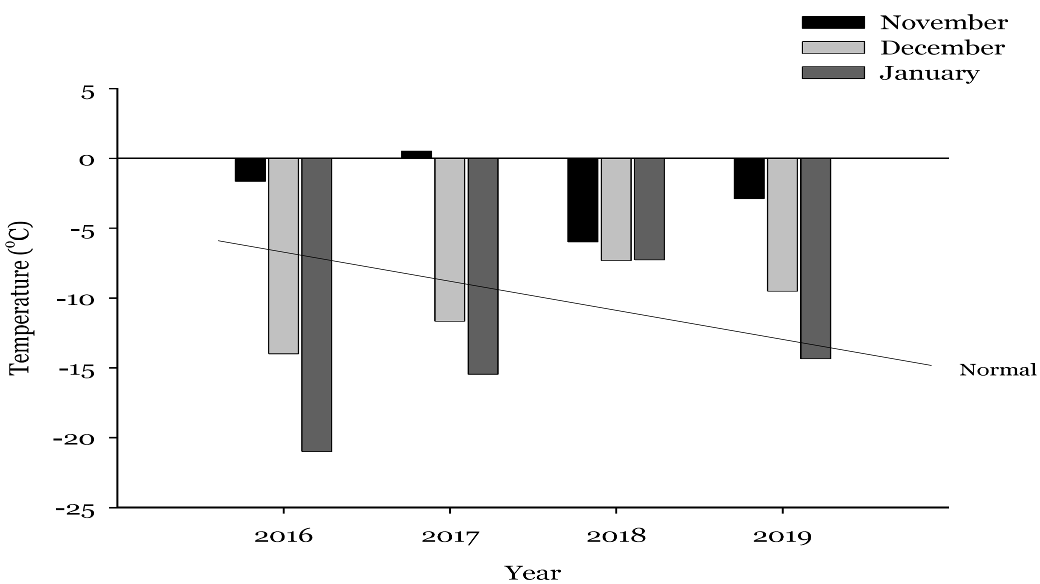

Figure 1. Monthly temperatures during bale grazing. November temperatures are for the last two weeks of the month and January temperatures are for the first two weeks of the month. Data from North Dakota Agricultural Weather Network.

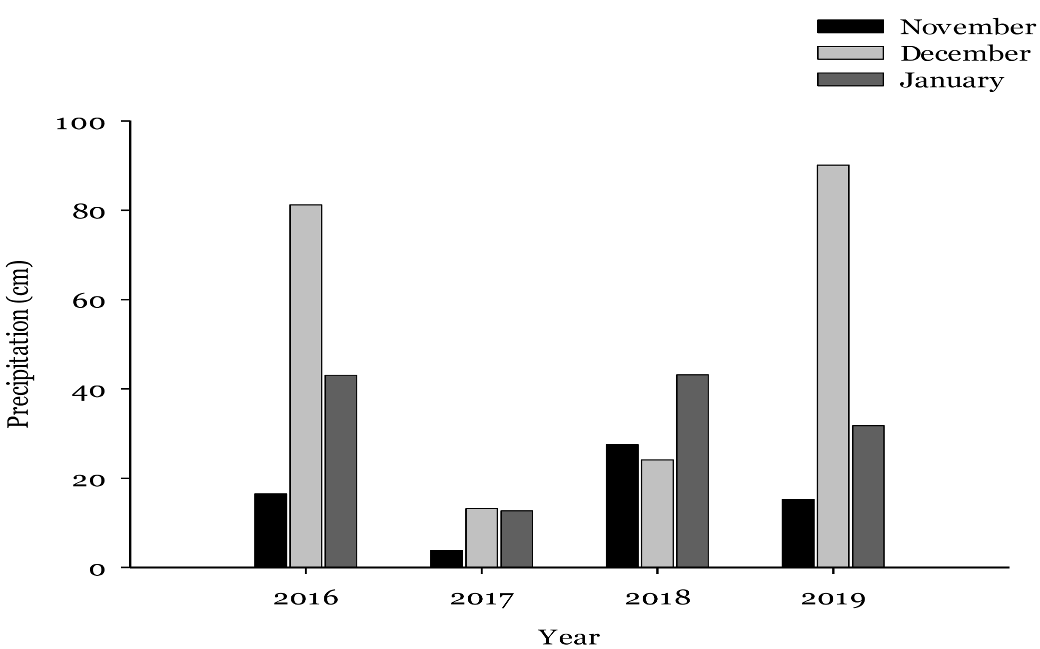

Figure 2. Precipitation during bale grazing. November precipitation is for the last two weeks of the month and January precipitation is for the first two weeks of the month. Data from National Oceanic and Atmospheric Administration (NOAA).

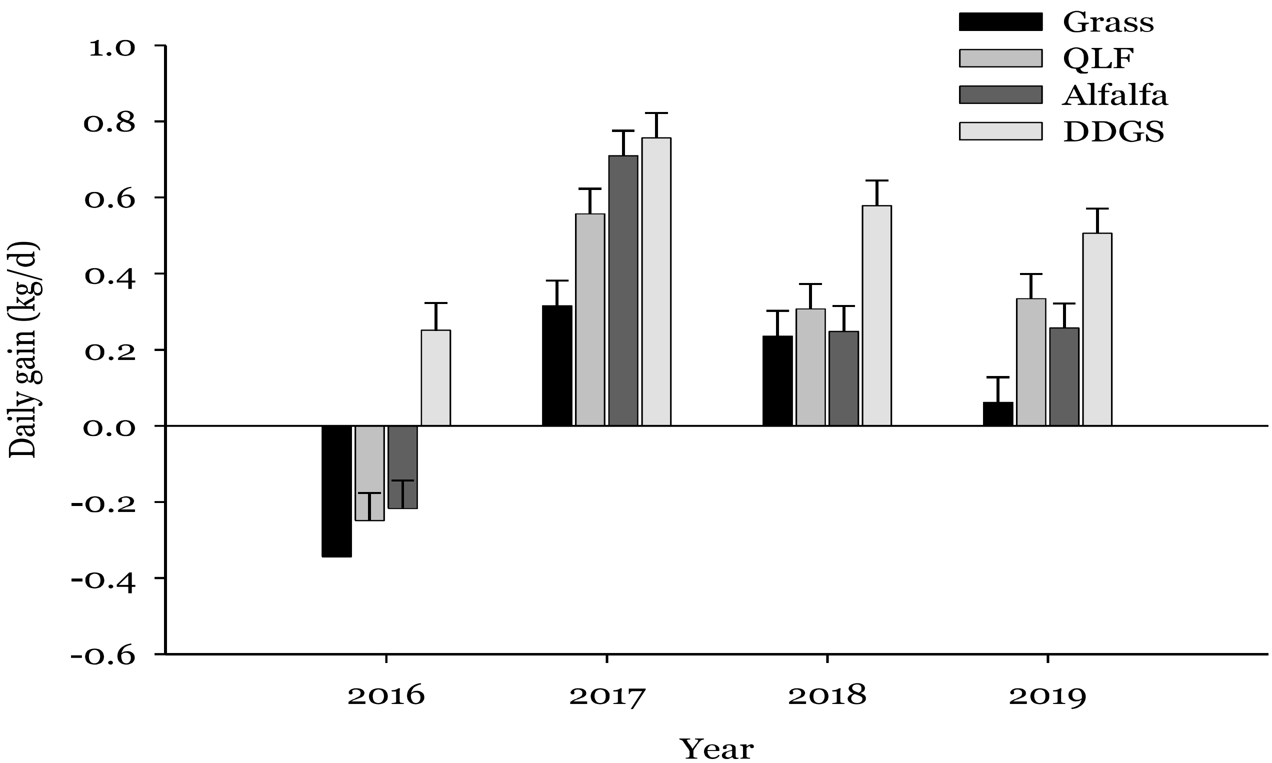

Figure 3. Cow daily gains following bale grazing grass hay or grass hay supplemented with alfalfa hay (alfalfa), a liquid supplement (QLF) or dried distillers' grains with solubles (DDGS).

Table 1. Nutrient composition (mean ± SD; % DM basis) of grass hay supplemented with alfalfa hay, a liquid supplement or DDGS during four grazing seasons.

	HAY[1]	ALF[2]	QLF[3]	DDGS[4]
CP	7.9 ± 0.51	10.8 ± 0. 71	9.0 ± 0.44	11.5 ± 0.48
TDN	55.1 ± 0.45	56.3 ± 1.06	54.7 ± 0.56	58.3 ± 0.77
NDF	66.3 ± 0.69	62.4 ± 1.38	65.4 ± 0.81	60.7 ± 0.37
ADF	47.3 ± 1.96	45.1 ± 1.27	48.8 ± 3.09	42.5 ± 1.01
Ca	0.61 ± 0.04	0.89 ± 0.03	0.54 ± 0.05	0.53 ± 0.04
P	0.11 ± 0.04	0.13 ± 0.04	0.16 ± 0.02	0.24 ± 0.04
Mg	0.18 ± 0.02	0.23 ± 0.02	0.16 ± 0.01	0.22 ± 0.02
K	0.77 ± 0.50	1.2 ± 0.41	0.91 ± 0.03	0.85 ± 0.41

[1]Grass hay, [2]Grass hay + alfalfa hay, [3]Liquid supplement-treated hay and [4]Grass hay + DDGS.

Table 2. Cow performance following bale grazing grass hay or grass hay supplemented with alfalfa hay, a liquid supplement or dried distillers grains with solubles.

	Diet (D)					Year (Y)					P-value		
	HAY[1]	ALF[2]	QLF[3]	DDGS[4]	SE	2016	2017	2018	2019	SE	D	Y	D x Y
Initial BW, kg	621	623	620	621	9.0	593^{c}	621^{b}	644^{a}	626^{ab}	7.9	0.994	<0.001	0.995
Final BW, kg	626^{bc}	638^{ab}	634^{ab}	654^{a}	9.5	583^{b}	659^{a}	663^{a}	645^{a}	8.5	0.025	<0.001	0.835
Daily gain, kg/day	0.07^{c}	0.24^{b}	0.25^{b}	0.52^{a}	0.05	-0.14^{c}	0.59^{a}	0.34^{b}	0.29^{b}	0.05	<0.001	<0.001	0.025
Initial BCS	5.8	5.8	5.8	5.8	0.05	5.6^{c}	5.4^{d}	5.8^{b}	6.5^{a}	0.05	0.965	<0.001	0.689
Final BCS	5.7^{b}	5.8^{ab}	5.8^{ab}	5.9^{a}	0.04	5.4^{c}	5.6^{b}	5.3^{c}	6.9^{a}	0.05	0.005	<0.001	0.710
BCS change	-0.08^{b}	0.03^{ab}	0.04^{a}	0.07^{a}	0.04	-0.13^{c}	0.22^{b}	-0.42^{d}	0.39^{a}	0.04	0.004	<0.001	0.230

[1]Grass hay, [2]Grass hay + alfalfa hay, [3]Liquid supplement-treated hay and [4]Grass hay + DDGS.
Means with a different letter within row for diet (D) or within row for year (Y) differ significantly ($P \leq 0.05$).

Table 3. Performance of calves from cows that bale grazed grass hay or grass hay supplemented with alfalfa hay, a liquid supplement or dried distillers' grains with solubles.

	Diet (D)					Year (Y)				P-value		
	HAY[1]	ALF[2]	QLF[3]	DDGS[4]	SE	2017	2018	2019	SE	D	Y	D x Y
Heifers												
Birth weight, kg	37	37	37	38	1.7	36	36	39	1.5	0.729	0.121	0.975
Weaning weight, kg	250	246	255	257	8.8	248^{ab}	245^{b}	265^{a}	7.6	0.614	0.023	0.978
205-day weaning wt, kg	279	262	273	278	9.8	285^{a}	269^{ab}	265^{b}	8.5	0.315	0.035	0.969
ADG, kg/day	1.18	1.10	1.15	1.17	0.05	1.21^{a}	1.13^{ab}	1.10^{b}	0.04	0.312	0.012	0.933
Bulls												
Birth weight, kg	40	39	39	42	1.6	39^{ab}	42^{a}	38^{b}	1.4	0.196	0.032	0.801
Weaning weight, kg	259	269	260	277	8.4	258^{b}	253^{b}	287^{a}	7.2	0.115	<0.001	0.852
205-day weaning wt, kg	284	292	277	299	10.0	297	278	289	8.7	0.172	0.082	0.661
ADG, kg/day	1.19	1.23	1.16	1.26	0.05	1.26^{a}	1.15^{b}	1.22^{ab}	0.04	0.241	0.029	0.637

[1]Grass hay, [2]Grass hay + alfalfa hay, [3]Liquid supplement-treated hay and [4]Grass hay + DDGS.
Means with a different letter within row for diet (D) or within row for year (Y) differ significantly ($P \leq 0.05$).