Supplementation of Beef Cattle Bale Grazing Grass Hay in Winter: Effects on Animal Performance and Soil Nutrients

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Ensuring that animals have adequate nutrition is important when bale grazing late in the season. For cows receiving poor-quality feed, this can be achieved by using supplementation methods that minimize labor and energy costs. This study examines methods of supplementing cows while bale grazing poor-quality hay. Results suggest that supplementation with good-quality alfalfa hay or a liquid supplement will not meet requirements of pregnant beef cows in early to mid-gestation in severely cold winters. Under such conditions, high-energy supplements such as corn dried distillers grains with solubles (DDGS) will be required to meet the nutrient shortfall. Supplementation with good-quality alfalfa hay or grass hay treated with a liquid supplement may be an option during mild winters.

Summary

Methods of supplementing beef cows bale grazing poor-quality grass hay were investigated in a study conducted during three winters, from 2016 to 2018, 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 method of supplementation depends on environmental conditions during the 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 the 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 help 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 techniques 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 methods of supplementing cows bale grazing poor-quality hay in the winter. The study examined beef cow performance and cost effectiveness of bale grazing supplementation strategies.

Procedures

This study extended for two years, from 2016 to 2017. Starting in the fall of each year, 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) were divided into eight groups of similar total body weight and kept on bale-grazing pasture in the winter. The cows were pregnancy-checked prior to the start of the study to eliminate open cows. Cows were treated with IVOMEC (Ivermectin) pour-on during sorting.

The bale grazing site was a 26-acre 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 field then was divided into eight three-acre paddocks using three-strand, high-tensile wire electric fencing.

Table 1. Composition of grass hay and hay supplemented with alfalfa hay (ALF), a liquid supplement (QLF) or dried distillers grains with solubles (DDGS).

	Control[1]	ALF[2]	QLF[3]	DDGS[4]
Nutrient composition, % DM				
Crude protein	7.5	9.9	8.8	11.1
Total digestible nutrients	51.7	54.1	51.0	55.2
Neutral detergent fiber	66.3	63.5	65.9	60.9
Acid detergent fiber	47.8	44.7	48.7	42.6
Calcium	0.56	0.91	0.51	0.48
Phosphorus	0.10	0.11	0.16	0.25
Potassium	0.77	1.03	0.93	0.84
Magnesium	0.18	0.23	0.15	0.21

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

One water tank was installed between two paddocks. The site was mowed prior to bale placement to reduce the possibility of cows grazing standing forage.

Forty round hay bales were placed in each paddock in two rows in the fall. Net wrap was removed prior to feeding. Bales were placed on their sides to reduce waste and loss of liquid supplement. Cows were allotted four bales at a time, and access to new bales was controlled using one portable electric wire. Windbreaks were placed in each paddock for protection.

Cows were assigned to one of four bale grazing treatments as follows: a) poor-quality hay (control), b) poor-quality hay supplemented with alfalfa hay, c) poor-quality hay supplemented with corn DDGS and d) poor-quality hay treated with a liquid supplement (Table 1). Poor-quality 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. Approximately 34 liters of liquid supplement (Quality Liquid Feeds Inc.) was poured onto upright bales. This amount of liquid supplement was calculated to increase hay protein content by approximately 3 percentage points.

Bales were allowed to sit upright after pouring until the supplement had seeped into the bale, after which the bales were flipped on their sides. One bale of alfalfa hay was fed for every three bales of poor-quality hay.

Cows had *ad libitum* access to water. Cows on the control, alfalfa hay and liquid supplement hay treatments were fed a 6-12+ mineral supplement (CHS Inc., Sioux Falls, S.D.). All cows were offered a salt block.

Two-day body weights were taken at the start and end of the study. Two observers assigned body condition scores (BCS) using a 9-point system (1 = emaciated, 9 = obese; Wagner et al., 1988; Rasby et al., 2014) at the start and end of the study. Animal handling and care procedures were approved by the NDSU Animal Care and Use Committee.

Soil samples were collected at two depths, 0 to 15 centimeters (cm) and 15 to 30 cm, and from three distance points, bale center, 10 feet from the bale center and 20 feet from the bale center. As well, soil samples were collected from bale grazed and ungrazed areas.

Results

Initial cow BW and BCS were similar ($P > 0.05$) among treatments in both years. Final BW and BCS were not influenced ($P > 0.05$) by treatment. The diet by year interaction ($P < 0.001$) for daily gain (Table 2) shows that response to supplementation was dependent on the type of supplement used, as well as environmental conditions.

In the first year, cows supplemented with DDGS had positive daily gains, while supplementation with alfalfa hay or liquid resulted in weight loss (Figure 1). In the second year, more favorable environmental conditions resulted in similar performance in supplemented cows, whereas in the third year, DDGS supplementation clearly was superior to the other supplementation strategies (Figure 1).

In the first year, supplementation did not influence ($P > 0.05$) soil organic matter, nitrate-N, ammonium-N, phosphorus (P) and potassium (K) at two soil depths (Table 3). As well, the distance from the center of the bale did not influence ammonium-N, P and K. However, nitrate-N content decreased linearly with increasing distance from the bale center. We found no difference in soil nutrients between bale grazed and ungrazed areas.

Table 2. Animal performance following bale grazing poor-quality grass hay supplemented with alfalfa hay, a liquid supplement or dried distillers grains with solubles (DDGS).

	Diet (D)					Year (Y)				P-value		
	HAY[1]	ALF[2]	QLF[3]	DDGS[4]	SE	2016	2017	2018	SE	D	Y	D x Y
Initial BW, kg	621	620	620	618	11.4	594^{b}	622^{a}	643^{a}	7.8	0.997	<0.001	0.729
Final BW, kg	624	635	632	651	12.1	583^{b}	661^{a}	662^{a}	8.9	0.165	<0.001	0.455
Daily gain, kg/d	0.07^{c}	0.25^{b}	0.21^{bc}	0.53^{a}	0.053	-0.13^{c}	0.58^{a}	0.34^{b}	0.045	<0.001	<0.001	0.009
Initial BCS	5.6	5.6	5.5	5.6	0.05	5.5b	5.4c	5.8a	0.04	0.939	<0.001	0.278
Final BCS	5.4	5.5	5.7	5.5	0.17	5.4	5.6	5.5	0.11	0.377	0.346	0.261
BCS change	-o.19	-0.11	0.12	-0.04	0.16	-0.08b	0.19a	-0.27b	0.11	0.298	<0.001	0.595

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

[a-c]Means within diet and within year with a different letter differ ($P \leq 0.05$).

Discussion

During the first year of this study (2016), three blizzards occurred, which led to heavy snow accumulation in the paddocks. Despite snow depths greater than 20 inches in select places, cows were able to bale graze for 70 days before the termination of the study.

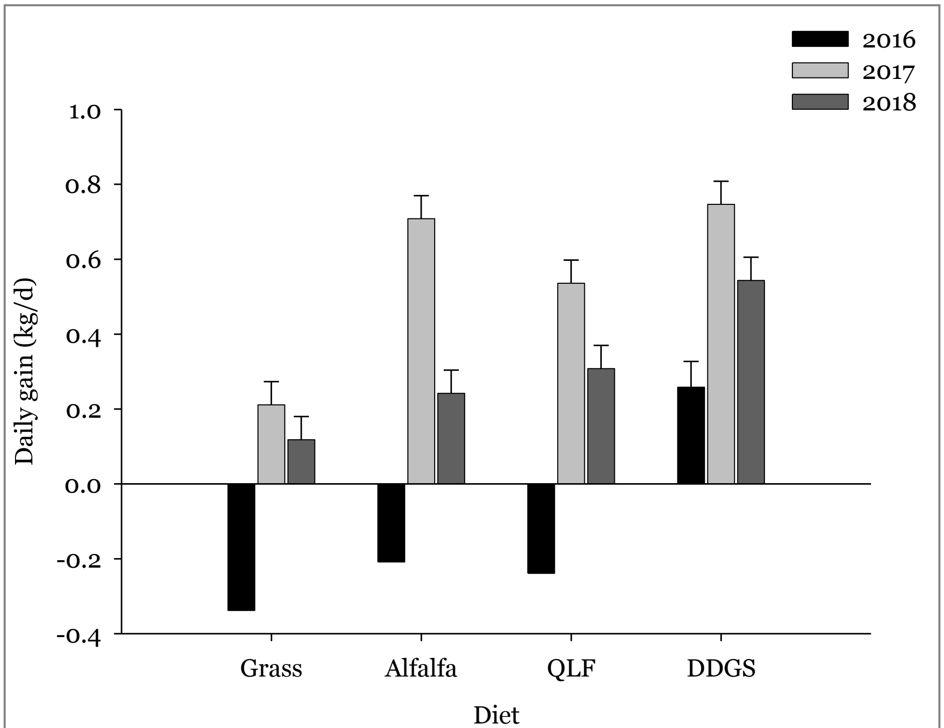

Figure 1. Cow daily gains following bale grazing grass hay supplemented with alfalfa hay (alfalfa), a liquid supplement (QLF) or dried distillers grains with solubles (DDGS).

The trial was terminated because cows no longer were able to reach the water source due to the heavy snowfall.

Environmental conditions will play a part in determining the success of supplementing cows bale grazing grass hay in the winter. When winters are harsh, poor-quality grass does not contain adequate amounts of energy, protein and phosphorus to meet nutritional requirement of cows in early to mid-gestation.

In the first year, cows supplemented with DDGS maintained BW and BCS, while cows supplemented with alfalfa hay or hay treated with a liquid supplement lost BW and BCS, suggesting that cow nutrient requirements were met by DDGS supplementation but not alfalfa hay or liquid supplementation. With more favorable winter conditions in the second year, supplementation with alfalfa hay, a liquid supplement or DDGS improved animal performance.

Results suggest that poor-quality grass hay does not contain adequate energy, protein and phosphorus to meet requirements of pregnant beef cows in early to mid-gestation when winters are severely cold. Under such conditions, supplementation with good-quality alfalfa hay or liquid supplement is not adequate and high-energy supplements such as corn DDGS will be required to meet the nutrient shortfall. Supplementation with good-quality alfalfa hay or grass hay treated with a liquid supplement may be an option during mild winters.

Table 3. Soil concentrations[1] of organic matter, ammonium-N, nitrate-N, phosphorus and potassium following bale grazing poor-quality hay supplemented with DDGS, alfalfa hay or a liquid supplement.

	Treatment (T)					Distance (D)				P-value			Distance effect	
	HAY	QLF	ALF	DDG	SE	0	10	20	SE	T	D	T x D	L	Q
Depth (0 – 15 cm)														
OM, %	0.58	0.46	0.62	0.59	0.070	0.53	0.57	0.57	0.014	0.267	0.039	0.020	0.033	0.107
NO_3-N, kg/ha	1.35	1.30	1.48	1.46	0.246	1.52[a]	1.64[a]	1.03[b]	0.151	0.862	0.009	0.511	0.012	0.024
NH_4-N, kg/ha	1.31	1.17	1.26	1.34	0.100	1.36	1.21	1.25	0.097	0.513	0.284	0.432	0.246	0.245
P, kg/ha	1.49	1.31	1.23	1.14	0.146	1.22	1.28	1.38	0.079	0.255	0.176	0.417	0.074	0.728
K, kg/ha	2.76	2.64	2.66	2.61	0.134	2.65	2.72	2.62	0.069	0.718	0.405	0.212	0.704	0.208
Depth (15 – 30 cm)														
OM, %	0.48	0.37	0.50	0.41	0.046	0.43	0.43	0.47	0.039	0.064	0.493	0.698	0.288	0.698
NO_3-N, kg/ha	1.12	0.98	1.21	1.09	0.229	1.33[a]	1.23[a]	0.74[b]	0.077	0.785	0.001	0.034	0.001	0.019
NH_4-N, kg/ha	1.18	1.22	1.20	1.41	0.104	1.34	1.20	1.22	0.061	0.269	0.133	0.246	0.145	0.161
P, kg/ha	1.31	1.16	0.99	0.86	0.274	1.11	1.06	1.08	0.103	0.478	0.901	0.733	0.787	0.724
K, kg/ha	2.59	2.51	2.51	2.51	0.087	2.52	2.53	2.53	0.050	0.770	0.973	0.242	0.840	0.909

[a-b]Means within treatment and within distance with a different letter differ ($P \leq 0.05$).

Linear and quadratic orthogonal polynomial contrasts.

[1]Log_{10} values for all means.

Acknowledgments

The excellent technical assistance provided by the late Rodney Schmidt, as well as Dwight Schmidt, Scott Alm, Megan Gross, Elisabeth Gnitka, Cody Wieland, Felipe Silva, Nico Negrin, Cheyanne Klein, Thomas Mittleider, Rick Bohn, Tom Lere (QLF) and Curt Lahr (QLF) is gratefully acknowledged.

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