Impact of protein source and supplementation frequency on growth performance of backgrounding cattle in an extensive winter grazing system

Jaime M. Chambers[1], Grady L. Gullickson[1], Madeliene S. Nichols[1], Yssi L. Entzi[1], Jessie G. Syring[1], Joshua V. Wianecki[1], Lydia E. Trandem[1], Garrett Havelka[1], Kendall C. Swanson[1], Miranda A. Meehan[1] and Zachary E. Carlson[1]

The objective of this experiment was to determine the influence of protein source (dried distiller's grains plus solubles or soybean meal) and supplementation frequency (daily or three times weekly) on growth performance of backgrounding cattle in a winter bale-grazing system. Results from the first year of the study suggest that protein source and frequency of supplementation did not influence growth performance. Therefore, the decision for a producer to reduce frequency of supplementation and replace dried distiller's grains plus solubles with soybean meal in backgrounded beef cattle diets should be based on cost and availability.

Summary

Seventy-two Angus-crossed backgrounding calves (initial BW = 549 ± 233) were used in a 44-day winter bale-grazing study that evaluated the differences in growth performance of calves supplemented with dried distiller's grains plus solubles (DDGS) or soybean meal (SBM) either daily or three times weekly. Body weights were collected at day 0, 28, and 44. Cattle had ad libitum access to water, hay, and trace mineralized salt., DDGS or SBM was supplemented (dry matter basis) at an average of 0.75% of their body weight per day so that all calves would receive the same amount of supplement over a seven-day period. There was no difference ($P \geq 0.05$) in ending body weight, average daily gain or estimated dry matter intake (DMI) between treatments. This suggests protein source and supplementation frequency have minimal effects on backgrounding cattle performance when managed in a bale-grazing system and that choice of supplementation should be based on availability and cost of the protein supplement.

Introduction

Extended grazing systems, such as bale grazing, have become more popular with producers in recent years due to decreased production costs. Animals are able to harvest their own feed while minimizing the cost of purchased feed (Undi and Sedivec, 2022). Much of the research on bale grazing focuses on gestating cows, and limited research has evaluated the system for backgrounding cattle. Grazing animals usually require supplemental energy and protein to achieve a desired gain (Kunkle et al., 2000) improvement of animal performance, increasing economic return, and(or. Dried distiller's grains plus solubles (DDGS) is commonly used to supplement energy and protein for cattle consuming or grazing forage. Soybean meal (SBM) supplies high concentrations of protein and is a balanced source of essential amino acids, particularly lysine, which is lower in corn and other cereal grains. However, the cost of SBM is high relative to other protein sources. With feed costs making up a large percentage of total production costs, SBM has not been a common feed ingredient in beef cattle diets for several years. With the growing interest in biodiesel, more soybeans are being produced and processed in North Dakota. This growth in soybean production and processing may increase the supply and availability of SBM at potentially lower prices, which could make it useful to producers as an alternative local feedstuff.

The objectives of this study were to evaluate differences in growth performance in backgrounding cattle supplemented with DDGS or SBM daily or three times per week in an extensive winter bale-grazing system.

[1]Department of Animal Sciences, North Dakota State University, Fargo, North Dakota, 58108

Experimental Procedure

Twenty-four heifers (initial BW = 482 ± 98 lb) and 48 steers (initial BW = 582 ± 148 lb) Angus-based backgrounding cattle were in a 44-day bale-grazing study on a pasture south of the NDSU Beef Cattle Research Complex in Fargo, North Dakota. Cattle originated from the NDSU Beef Unit. This study was conducted from December 2023 to January 2024.

The study pasture was split into 15 paddocks of 40 ft × 400 ft (0.44 acres) using polywire electric fence. Grass hay round bales were individually weighed and placed in the middle of each paddock with 40 ft between each bale so 10 bales per paddock. Cattle were given access to one bale at a time by moving the polywire electric fence. Cattle were limit-fed a common diet at an estimated 2% of their body weight (dry matter basis) for the five days prior to the initiation and at the completion of the study and weighed on three consecutive days at the beginning and end of the study to equalize gut fill (Watson et al., 2013). Using the average body weight from the first and second days, cattle were stratified and randomly assigned to one of four treatments. The four treatments were DDGS fed daily (DDGS-d), DDGS fed three times per week (DDGS-a), SBM fed daily (SBM-d) and SBM fed three times per week (SBM-a). Each treatment was replicated three times and randomly assigned to a paddock.

Calves were allowed ad libitum access to water, hay, and trace mineralized salt (American Stockman Big 6 Mineral Salt, NaCl 96-99%, Mn 2,400 ppm, Fe 2,400 ppm, Cu 260-380 ppm, Zn 320 ppm, I 70 ppm, and Co 40 ppm). Cattle that were supplemented daily received 0.75% of BW (dry matter basis), and cattle supplemented three times a week received 1.75% of BW (dry matter basis).

Body weights were collected every 28 days. Weekly feed ingredient samples were collected and ground through a 1-mm screen using a Wiley Mill (Thomas Scientific, Swedesboro, NJ) and then composited into four-week composites. Dietary dry matter was determined for every new pallet delivery of feed by sampling ingredients and oven-drying at 60 C for 48 hours. Adjustments were made to supplement fed to calves. Feed weigh-backs were collected over the entire experiment and stored at -4 C for dry matter analysis at a later date. The residue of one bale per paddock was collected and weighed in the spring to estimate residual hay left in the paddock and hay intake.

Data were analyzed using the MIXED procedure in SAS (SAS Inst. Inc., Cary, NC). Significance was assigned at $P \leq 0.05$ with a tendency assigned between $P < 0.10$ and > 0.05.

Table 1. Nutrient composition of feedstuffs

Item, %	Hay[1]	DDGS Mix[2]	SBM Mix[3]
DM	90.01	89.92	89.83
CP	9.97	33.24	50.77
Fat	1.94	6.20	1.16
NDF	68.90	47.81	10.95
ADF	38.60	17.80	4.55
Ash	8.73	10.29	1.39
Calcium	0.37	1.72	1.46
Phosphorus	0.22	0.99	0.69
Nitrogen	1.59	5.32	8.12
Sulfur	0.14	0.69	0.40

[1]Low-quality grass hay
[2]Dried distiller's grains plus solubles; 97% DDGS and 3% limestone (DM basis)
[3]Soybean meal; 97% SBM and 3% limestone (DM basis)

Results and Discussion

There were no protein source × supplementation frequency interactions ($P = 0.49$) for average daily gain (ADG), ending bodyweight (EBW) or estimated dry matter intake (DMI) (Table 2). There were no differences ($P = 0.32$) due to supplementation frequency for ADG, EBW or estimated DMI. Likewise, there were no differences ($P = 0.21$) due to protein source for ADG or EBW. There was a tendency ($P = 0.09$) for cattle supplemented with SBM to have a greater DMI than cattle supplemented with DDGS.

Table 2. Growth performance and estimated dry matter intake of backgrounding cattle in a bale-grazing system

	Treatment[1]					P-Value		
Item	DDGS-d	DDGS-a	SBM-d	SBM-a	SEM	TRT[3]	FREQ[4]	TRT x FREQ
Calves, n	18	18	18	18	-	-	-	-
Initial BW, lb	531.77	533.32	532.55	531.99	8.8	0.98	0.95	0.90
Ending BW, lb	629.57	623.4	623.57	621.68	9.6	0.68	0.67	0.82
ADG, lb/day	2.23	2.05	2.07	2.04	0.11	0.42	0.32	0.49
DMI[2], lb/day	10.84	10.83	12.19	11.94	0.64	0.09	0.84	0.85

[1]Treatments; DDGS-d: dried distiller's grains plus solubles fed daily; DDGS-a: dried distiller's grains plus solubles fed 3 times per week; SBM-d: soybean meal fed daily; SBM-a: soybean meal fed 3 times per week
[2]Dry Matter Intake: estimated as individual animal intake was not monitored
[3]TRT; Treatment – DDGS vs SBM
[4]FREQ; Frequency – daily vs 3x per week

These results agree with previous research that suggests protein supplementation can be offered on an infrequent basis to ruminants while still maintaining cattle performance (Huston et al., 1999; Bohnert et al., 2002). Note that we replaced SBM in the diet at the same inclusion level as DDGS, on a dry matter basis, and did not formulate the diets to have balanced metabolizable energy or protein. Other research also suggests that as supplemented crude protein increases, there is a corresponding increase in forage dry matter intake (DMI) when consuming a low-quality forage (Cappellozza et al., 2021). Unlike our results with no difference in DMI, research has shown that as supplement frequency decreases, there is also a decrease in forage DMI. This difference may be because most of the research is on gestating beef cattle and not backgrounding calves, which have differing energy and protein requirements. However, caution is warranted in our study as hay intake was estimated from the amount of hay residue remaining post-grazing from one bale per paddock.

Our results suggest that a producer can utilize an extended winter bale-grazing system with backgrounding cattle while supplementing DDGS or SBM as few as three times a week. The decision to use SBM rather than DDGS will most likely be made based on supplement cost, transportation cost, and availability.

Acknowledgements

The authors thank the North Dakota Soybean Council for providing financial support. The authors also thank the staff and students at the NDSU Beef Cattle Research Complex, NDSU Beef Unit, and NDSU Nutrition Laboratory.

Literature Cited

Bohnert, D. W., C. S. Schauer, and T. DelCurto. 2002. Influence of rumen protein degradability and supplementation frequency on performance and nitrogen use in ruminants consuming low-quality forage: Cow performance and efficiency of nitrogen use in wethers. J. Anim. Sci. 80:1629–37.

Cappellozza, B. I., D. W. Bohnert, M. M. Reis, K. C. Swanson, S. J. Falck, and R. F. Cooke. 2021. Influence of amount and frequency of protein supplementation to steers consuming low-quality, cool-season forage: intake, nutrient digestibility, and ruminal fermentation. J. Anim. Sci. 99:skab112.

Huston, J. E., H. Lippke, T. D. A. Forbes, J. W. Holloway, and R. V. Machen. 1999. Effects of supplemental feeding interval on adult cows in Western Texas. J. Anim. Sci. 77:3057–67.

Kunkle, W. E., J. T. Johns, M. H. Poore, and D. B. Herd. 2000. Designing supplementation programs for beef cattle fed forage-based diets. J. Anim. Sci. 77:1.

Undi, M., and K. K. Sedivec. 2022. Long-term evaluation of bale grazing as a winter-feeding system for beef cattle in central North Dakota. Appl. Anim. Sci. 38:296–304.

Watson, A. K., B. L. Nuttelman, T. J. Klopfenstein, L. W. Lomas, and G. E. Erickson. 2013. Impacts of a limit-feeding procedure on variation and accuracy of cattle weights1. J. Anim. Sci. 91:5507–5517.