Evaluation of protein supplementation strategies on performance of backgrounding cattle in an extensive winter grazing system

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

The objective of this experiment was to determine the influence of protein source (dried distillers 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 two-year study suggest that neither protein source nor frequency of supplementation influenced growth performance. Therefore, the decision for a producer to reduce frequency of supplementation and replace dried distillers grains plus solubles with soybean meal in backgrounding beef cattle diets should be based on cost and availability.

Summary

In year 1, 72 crossbred backgrounding calves (initial body weight [BW] = 549 ± 59 lb) were utilized for 44-days, and in year 2, 65 crossbred backgrounding calves (initial BW = 593 ± 77 lb) were utilized in a 92-day winter bale-grazing study to evaluate the differences in growth performance of calves supplemented with dried distillers grains plus solubles (DDGS) or soybean meal (SBM) either daily or three times weekly. In year 1, body weights and blood were collected at day 0, 28 and 44. In year 2, body weights were collected at day 0, 28, 56, 84 and 92 and blood was collected at day 0, 56 and 92. Cattle had ad libitum access to water, hay and trace mineralized salt. Supplements were provided at an average of 0.75% of their body weight per day (dry matter basis) so that all calves would receive the same amount of supplement over a seven-day period. There were no differences ($P \geq 0.05$) in ending body weight or average daily gain between treatments. Estimated hay dry matter intake (DMI) in year 2 was higher for daily fed paddocks compared to three times weekly. This suggests that 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

Cattle overwintered in open dry lot pens is a common practice in the northern Great Plains (Asem-Hiablie et al., 2016). Extending the grazing season through a system such as bale grazing has become more popular with producers in recent years due to the animals' ability to harvest their own feed, which can decrease production costs (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. Backgrounding cattle typically have greater nutrient requirements as a percent of their diet than mature cows. Therefore, supplemental feed is usually required for cattle in a backgrounding program on pasture to achieve gains that promote continued growth (NASEM, 2016). Dried distillers 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. Since feed costs make up a large percentage of total production costs, SBM has not been a common feed ingredient in beef cattle diets for several years. The growing interest in biodiesel has resulted in more soybeans 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 objective of this study was to evaluate differences in growth

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

performance in backgrounding cattle supplemented with DDGS or SBM daily or three times per week in an extensive winter bale-grazing system.

Experimental Procedure

A 44-day bale graaing study was conducted In year 1 (Y1) using 24 heifers (initial BW = 482 ± 98 lb) and 48 steers (initial BW = 582 ± 148 lb), followed by a 92-day study in year 2 (Y2) using 65 steers (initial BW = 593 ± 77 lb). Crossbred backgrounding cattle were grazed in a field south of the NDSU Beef Cattle Research Complex in Fargo, North Dakota. Cattle originated from the NDSU Beef Unit. This study was conducted in Y1 from Dec. 6, 2023, to Jan. 19, 2024, and in Y2 from Dec. 11, 2024, to March 13, 2025.

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 for a total of 10 mixed grass hay round bales per paddock. The bales for Y2 grazing were placed between the bale locations from Y1. 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 BW (dry matter basis) for the five days prior to the initiation and weighed on three consecutive days (Y1) and two consecutive days (Y2) at the beginning and end of the study to equalize gut fill (Watson et al., 2013). Using the average body weight, 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 within the year and randomly assigned to a paddock.

Table 1. Nutrient composition of feedstuff

	Year 1			Year 2		
Item[1], %	Hay[2]	DDGS[3]	SBM[4]	Hay	DDGS	SBM
DM	97.51	89.92	89.83	97.64	91.13	91.16
CP	9.97	33.24	50.77	7.65	27.77	49.35
Fat	1.94	6.20	1.16	1.51	5.19	2.11
NDF	68.90	47.81	10.95	67.10	44.12	9.62
ADF	38.60	17.80	4.55	39.14	14.20	4.27
Ash	8.73	10.29	9.95	9.36	11.33	10.73
Calcium	0.37	1.72	1.46	0.39	1.81	1.77
Phosphorus	0.22	0.99	0.69	0.24	1.10	0.75
Nitrogen	1.59	5.32	8.12	1.22	4.44	7.90
Sulfer	0.14	0.69	0.40	0.21	0.61	0.42

[1]Items: DM – dry matter; CP – crude protein; NDF – neutral detergent fiber; ADF – acid detergent fiber
[2]Fair quality mixed grass hay
[3]Dried Distillers Grains plus Solubles; 97% DDGS and 3% limestone (DM basis).
[4]Soybean Meal; 97% SBM and 3% limestone (DM basis)

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 and blood were collected every 28 days in Y1. In Y2, body weights were collected every 28 days and blood was collected on days 0, 56 and 92. Blood was collected via jugular venipuncture, processed into serum and stored at minus 4 degrees Celsius until further analysis. Blood was analyzed for serum urea nitrogen (SUN). 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 degrees for 48 hours. Adjustments were made to the supplement fed to calves. Feed weigh-backs were collected over the entire experiment and stored at minus 4 degrees 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.

Results and Discussion

There were no protein source × supplementation frequency interactions ($P \geq 0.11$) in both years for average daily gain (ADG), ending bodyweight (EBW) or estimated hay dry matter intake (DMI) (Table 2). There were no differences ($P \geq 0.30$) in supplementation frequency in ADG and EBW for either year or DMI for Y1. In Y2, DMI was increased ($P = 0.002$) for the daily (10.21 lb/day) fed paddocks compared to the alternate (8.43 lb/day). There were no differences ($P \geq 0.25$) in protein source in Y1 or Y2 for ADG, EBW, and Y2 for DMI. There was a tendency ($P = 0.09$) for SBM-fed paddocks (12.07 lb/day) to have higher estimated hay DMI in Y1 compared to DDGS (10.84 lb/day).

Across all treatments and years, SUN increased as the feeding period progressed (Figure 1). In Y1, SBM-d had the highest SUN at 30 mg/dL, compared to SBM-a at 22.90 mg/dL and the DDGS treatments at roughly 18.46 mg/dL at the end of the feeding period. In Y2, the DDGS treatments had the lowest SUN at roughly 17 mg/dL; however, SBM-a had the highest levels at 41 mg/dL. Differences between years may be attributed to differences in the collection day of blood relative to when supplementation occurred.

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). However, other research suggests that as supplemented crude protein increases, there is a corresponding increase in forage DMI when consuming a low-quality forage (Cappellozza et al., 2021). Similar to the Y2 results of hay DMI, research has shown that as supplement frequency decreases, forage DMI also decreases (Bohnert et al., 2002).

Our results suggest that a producer can utilize an extended

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

	Treatment[1]					P-Value[2]		
Item	DDGS-d	DDGS-a	SBM-d	SBM-a	SEM	TRT	FREQ	TRT x FREQ
Year 1								
Calves, n	18	18	18	18	-	-	-	-
Initial BW[3], lb	531.77	533.32	532.55	531.99	2.60	0.92	0.85	0.69
Ending BW, lb	629.57	623.4	623.57	621.68	4.85	0.44	0.34	0.50
ADG, lb/day	2.23	2.05	2.07	2.04	0.09	0.43	0.32	050
DMI[4], lb/day	10.84	10.83	12.19	11.94	10.64	0.09	0.84	0.85
Year 2								
Calves, n	17	17	14	17	-	-	-	-
Initial BW, lb	599.22	587.53	591.72	592.60	20.13	0.95	0.79	0.76
Ending BW, lb	714.30	716.50	718.49	703.05	6.25	0.47	0.30	0.17
ADG, lb/day	1.32	1.32	1.37	1.19	0.08	0.65	0.30	0.27
DMI, lb/day	10.32	7.85	10.10	9.02	0.17	0.25	**0.002**	0.11

[1]Treatments; DDGS-d: dried distillers grains plus solubles fed daily; DDGS-a: dried distillers grains plus solubles fed 3 times per week; SBM-d: soybean meal fed daily; SBM-a: soybean meal fed three times per week
[2]P-values: TRT – Treatment (DDGS vs SBM) and FREQ (daily vs three times per week)
[3]BW: body weight
[4]Dry Matter Intake: estimated hay intake as individual was not monitored

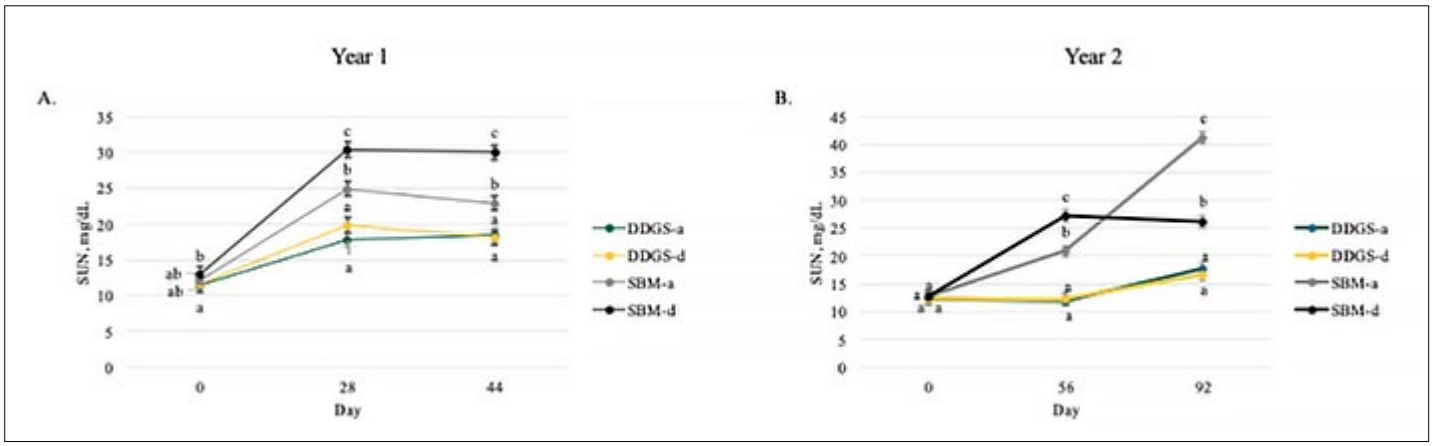

Figure 1. A) Serum urea nitrogen (SUN) concentrations for year 1. B) SUN concentrations for year 2. Treatments; DDGS-d: dried distillers grains plus solubles fed daily; DDGS-a: dried distillers grains plus solubles fed three times per week; SBM-d: soybean meal fed daily; SBM-a: soybean meal fed three times per week.[a-c]Letters denote significant difference ($P \leq 0.05$) within each time point.

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.

Acknowledgments

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

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

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.

National Academies of Sciences, Engineering, and Medicine. 2021. Nutrient requirements of dairy cattle, eighth revised edition. Washington, DC: The National Academies Press.

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.