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Effects of Alternative Feed Timing on Growth Performance and Water Usage of Growing Beef × Dairy Heifers Fed a High Roughage Diet

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Abstract

An 84-day feeding study was conducted to determine the effects of feed timing of high-roughage diets on growth performance, water usage, and heat stress exposure on beef × dairy heifers. A total of 260 heifers (initial body weight 459 ± 29 lb) were blocked by weight and randomly assigned to 20 pens, each containing 13 head. Pens were randomly assigned to one of two experimental treatments: fed at 7:00 a.m. (AM) or fed at 7:00 p.m. (PM). Heifers were offered feed for *ad libitum* intake with *ad libitum* access to water. At the conclusion of the study, final body weight, average daily gain, dry matter intake, and feed efficiency did not differ ($P \geq 0.47$) between the treatments. Water consumption was greater ($P < 0.01$) for AM heifers compared to PM (10.88 versus 10.36 gal/head/day, respectively). These data suggest that shifting feed timing of high roughage growing diets does not affect growth performance in beef × dairy heifers but could afford producers the opportunity to reduce water usage.

Introduction

High-roughage diets are the industry standard when transitioning freshly weaned calves to the feedlot. During this transition time, growing cattle face environmental stressors, such as heat stress, that can reduce animal comfort and performance. Enteric heat production from ruminal fermentation peaks 4 to 6 hours after feeding, often coinciding with the hottest part of the day, adding to the heat stress conditions of the outside environment. Implementing shade structures could mitigate the effects of heat stress; however, those structures represent a costly investment and may not be economically viable for some producers. Shifting feeding time, consequently shifting peak fermentation, to the evening may be an effective alternative to mitigate added heat stress without the added cost of shade structures. Therefore, the objective of this study was to evaluate the effects of altered feed timing (morning versus evening) on growth performance and water usage in growing fed beef × dairy heifers fed for *ad libitum* intake.

Experimental Procedure

A total of 260 black-hided beef × dairy heifers (initial body weight [BW] = 459 ± 29 lb) were purchased in southwest Kansas and transported to the Kansas State

University Beef Stocker Unit in late May 2025. Heifers were placed in a randomized, complete-block design and were fed for 84 days. Heifers were fed a common diet for two days with *ad libitum* access to water. On day 1, heifers were individually weighed in a hydraulic chute (Silencer, Moly Manufacturing Inc., Loraine, KS) and assigned a visual identification ear tag. Heifers arrived with electronic identification tags, and their individual numbers were recorded. Heifers were blocked by weight (light and heavy). Within the block, heifers were stratified by weight and randomly assigned to 20 pens containing 12 or 13 head. Pens were randomly assigned one of two treatments (10 reps per treatment). The experimental treatments were fed a high-roughage diet formulated to provide 50 Mcal of net energy for gain/100 lb dry matter (DM) for *ad libitum* intake at either 7:00 a.m. (AM) or 7:00 p.m. (PM). Refusals were targeted at 10% and daily feed calls were made 30 minutes before feeding to adjust feed allotments. Pen weights were collected every 14 days to monitor growth performance. During pen weights, feed that remained in the bunk was collected and weighed to determine feed refusal and adjust DM intake.

Water usage data was collected using individual water meters (SENSUS, Morrisville, NC) connected to each water tank in the pen. The total daily water usage of the pen was divided by the number of head in each pen to determine gal/head/day. Temperature, relative humidity, wind speed, and solar radiation were collected four times/day (1:00 a.m., 7:00 a.m., 1:00 p.m., and 7:00 p.m.) using a Davis weather station (Vantage Pro 2; Davis Instruments Corporation, Hayward, CA). Weather condition data were used to quantify heat stress exposure using the comprehensive climate index (CCI) adopted from Mader et al. (2010).

Results and Discussion

At the conclusion of the 84-day feeding period, final BW, DM intake, average daily gain, and gain:feed did not differ ($P \geq 0.47$) between AM and PM. Water usage was greater ($P < 0.01$) for AM heifers compared to PM. Heifers fed at 7:00 a.m. consumed 0.52 gal/head/day more than heifers fed in the evening. Offering feed for *ad libitum* intake allowed cattle to have access to feed at any time during the day and night.

The lack of treatment differences in growth performance could reflect the heifer's ability to regulate intake using their own natural feeding patterns. Cattle fed for *ad libitum* intake typically consume one large meal when feed is delivered and 8 to 9 hours later with smaller meals throughout the day (Schwartkopf-Genswein et al., 2003). During the afternoon, when CCI typically reached its maximum, heifers were often not eating, which could have reduced potential negative effects associated with heat stress and the added heat from ruminal fermentation.

Weather conditions during the study were relatively mild, and CCI values indicated limited exposure to mild and moderate heat stress. This is likely attributed to the lack of treatment differences. The mild CCI values observed were likely not enough to modify heifer behavior, and thus, heifers continued with normal diurnal patterns of eating and drinking.

Implications

Results from this experiment suggest that shifting the time of feeding high-roughage diets fed for *ad libitum* intake does not affect the growth performance of growing beef × dairy heifers under a mild heat load. However, shifting feed time did reduce water

consumption when heifers were fed in the evening. This could provide producers in the High Plains region who are facing water sustainability issues an opportunity to conserve water without sacrificing animal performance.

References

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Table 1. Growth performance and water usage of growing beef × dairy heifers fed a high roughage diet for *ad libitum* intake

	Treatment[1]			
Item	**AM**	**PM**	**SEM[2]**	***P*-value**
Initial body weight, lb	459	459	28.708	0.78
Final body weight, lb	665	664	13.930	0.98
Average daily gain, lb/day	2.44	2.44	0.368	0.99
Dry matter intake, lb/day	18.56	18.35	0.783	0.47
Gain:feed, lb/lb	0.14	0.13	0.002	0.51
Feed:gain, lb/lb	7.60	7.52	0.080	0.89
Water usage, gal/day[3]	10.88[a]	10.36[b]	0.108	< 0.01

[1] AM = feed delivered at 7:00 a.m.; PM = feed delivered at 7:00 p.m.
[2] Largest standard error of the means.
[3] Calculated by dividing total daily pen water usage by number of head in pen.
[ab] Within row, means with uncommon superscripts differ ($P \leq 0.05$).

Table 2. Weather conditions collected at the Kansas State Beef Stocker Unit during summer 2025

Item[1]	May	June	July	August	Overall
Temperature, F°					
Mean	72 ± 10	76 ± 9	80 ± 8	79 ± 9	78 ± 9
Maximum	86	94	95	97	97
Minimum	59	53	62	59	53
Relative Humidity, %					
Mean	61 ± 15	67 ± 11	69 ± 9	67 ± 10	67 ± 10
Maximum	79	81	80	95	95
Minimum	41	27	43	43	27
Wind speed, mi/hour					
Mean	6 ± 3	7 ± 6	6 ± 4	6 ± 4	6 ± 15
Maximum	11	24	17	18	24
Minimum	2	0	0	0	0
Solar radiation, W/m^2					
Mean	360 ± 342	273 ± 312	234 ± 302	212 ± 296	245 ± 305
Maximum	684	766	978	931	978
Minimum	0	0	0	0	0
CCI, C°[2]					
Mean	21 ± 9	24 ± 7	26 ± 6	26 ± 6	25 ± 7
Maximum	32	37	41	38	41
Minimum	7	6	12	13	6

[1] Weather data collected by Davis Weather station.
[2] Comprehensive climate index (CCI) equation adopted from Mader et al. (2010).