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Effects of Alternative Feed Timing on Growth Performance and Water Usage in Limit Fed Growing Beef × Dairy Heifers

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Abstract

An 84-day study was conducted to determine the effects of alternative feeding timing on growth performance and water usage during heat stress conditions in limit-fed growing beef × dairy heifers. A total of 257 beef × dairy heifers (initial body weight [BW] = 470 ± 28 lb) were blocked by weight. Within the block, heifers were stratified by arrival BW and randomly assigned to 20 pens containing 12 or 13 head. Within the block, pens were randomly allocated to one of two treatments (10 replications per treatment). Cattle were fed a diet formulated to provide 60 Mcal of net energy for gain/100 lb of dry matter (DM), limit fed at 2.2% BW (DM basis) at either 7:00 a.m. (AM) or 7:00 p.m. (PM). Individual BW was measured at the beginning and end of the feeding period. Pen weights were measured every 14 days and used to adjust feed delivery to limit-fed pens for the following 14 days. Final BW, average daily gain, gain:feed, and DM intake did not differ $P \geq 0.62$ between AM and PM heifers. Water usage was greater ($P < 0.01$) for AM heifers compared to PM heifers. Overall, producers could offer limit-fed diets in the evening to reduce water usage without sacrificing growth performance.

Introduction

Limit feeding a high-energy diet with corn coproduct inclusions can improve growing cattle performance, efficiency, and reduce water usage compared to a traditional growing diet fed for *ad libitum* intake. Environmental conditions, particularly heat stress, can reduce animal comfort and subsequently reduce animal performance. DeBord et al. (2024) observed that limit-fed cattle had reduced instances of heat stress compared to cattle fed for *ad libitum* intake. Because enteric heat production from ruminal fermentation peaks 4 to 6 hours after feeding (Yost, 2024), limit feeding higher energy rations could shift peak ruminal fermentation to earlier in the day when temperatures have not reached heat stress conditions. Additionally, limit feeding and providing shade during the summer months have been shown to improve cattle performance and reduce water usage (DeBord et al., 2024). However, shade structures represent a costly investment for producers and may not be economically viable. Shifting the feeding time to the evening could also help mitigate the added heat stress from fermentation 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 of growing limit-fed beef × dairy heifers.

Experimental Procedures

A total of 257 black-hided dairy-derived beef heifers (initial body weight [BW] = 470 ± 28 lb) were purchased from a single source in southwest Kansas and transported to the Kansas State University Beef Stocker Unit. Upon arrival, heifers were put into 13-head pens by order of arrival. Heifers were offered warm-season grass hay at 1.0% of body weight (dry matter [DM] basis) with *ad libitum* access to water. The following day, each heifer was individually weighed in a hydraulic squeeze chute (Silencer, Moly Manufacturing Inc., Loraine, KS) and assigned an individual visual identification ear tag. Heifers were blocked into two groups by weight. Within the block, heifers were stratified by weight and randomly assigned to 20 pens containing 13 head. Within the block, pens were randomly assigned one of two treatments (10 replications per treatment). The cattle in the experimental treatments were limit fed a diet formulated to provide 60 Mcal of net energy for gain/100 lb DM at 2.2% BW (DM basis) at either 7:00 a.m. (AM) or 7:00 p.m. (PM). Diets were mixed and delivered using a Roto-Mix feed wagon (Model #414B; Roto-Mix, Dodge City, KS). Pen weights were conducted every 14 days to adjust feed deliveries and calculate growth performance. Pen weights were conducted an hour before feeding (6:00 a.m. for the 7:00 a.m. feeding and 6:00 p.m. for the 7:00 p.m. feeding).

Water consumption was monitored with individual water meters (SENSUS, Morrisville, NC) connected to each water tank. The total daily water usage was divided by the number of head in each pen to determine gal/head/day. Weather conditions were measured 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) located in the center of the feedlot. Weather condition measurements were used to calculate a comprehensive climate index (CCI) to quantify heat stress exposure.

Results and Discussion

Final BW, average daily gain, DM intake, and feed:gain did not differ ($P \geq 0.62$, Table 1) between the AM and PM treatments. Mader et al. (2010) determined that cattle experience heat stress conditions at times when the CCI exceeds 25. Table 2 outlines the weather conditions during the summer months of our study. Only during July and August did the CCI exceed a CCI of 25 at 26.2 in both months. A CCI between 25 and 30 represents mild heat stress exposure and only occurred during peak sun exposure in the mid-afternoon. Because the environmental conditions during our study never reached conditions to induce moderate to severe heat stress, cattle comfort and performance were likely not affected. As mentioned, enteric heat production from ruminal fermentation generally peaks 4 to 6 hours after feeding. The AM heifers typically consumed their daily feed allotment 2 to 4 hours after feeding; subsequently, peak fermentation would have been between 1:00 p.m. and 3:00 p.m. The highest CCI in our study peaked between 3:00 p.m. and 5:00 p.m. The differences between peak enteric heat production and CCI likely helped further reduce heat stress exposure. Subsequently, PM heifers never experienced a CCI greater than 25.

Water usage was greater ($P < 0.01$) for AM heifers compared to PM heifers. Heifers fed at 7:00 a.m. on average used 0.88 gal/head/day more than PM heifers. In the High Plains region, the rate of depletion of available groundwater for agricultural use has steadily decreased over the years (Tollefson, 2025). New efforts in management practices by producers to reduce water usage have become paramount in many parts of the region as an attempt to maintain water sustainability. Shifting the feed timing to the

evening when heat exposure is minimized can help producers reduce their water usage without sacrificing cattle growth performance.

Implications

Our results suggest that shifting the feeding to evening hours does not negatively affect the growth performance of growing beef × dairy heifers, but it does reduce water usage.

References

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Table 1. Growth performance and water usage of growing limit fed beef × dairy heifers

	Treatment[1]			
Item	**AM**	**PM**	**SEM[2]**	***P*-value**
Initial body weight, lb	470	470	9.163	0.99
Final body weight, lb	643	644	12.626	0.95
Average daily gain, lb/day	2.06	2.07	0.075	0.93
Dry matter intake, lb/day	12.08	12.28	0.281	0.63
Gain:feed, lb/lb	0.17	0.17	0.006	0.81
Feed:gain, lb/lb	5.89	6.07	0.248	0.62
Water usage, gal/day[3]	10.42[b]	9.54[a]	0.100	< 0.01

[1] AM = fed at 7:00 a.m.; PM = fed 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.
[a,b] 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	72.3 ± 10.1	75.8 ± 8.9	79.9 ± 7.9	78.9 ± 8.9	78.0 ± 8.8
Maximum	86	94	95	97	97
Minimum	59	53	62	59	53
Relative humidity, %					
Mean	60.6 ± 15	66.5 ± 10.9	68.5 ± 9.2	66.7 ± 10.4	67.2 ± 10.4
Maximum	79	81	80	95	95
Minimum	41	27	43	43	27
Wind speed, mi/h					
Mean	5.8 ± 3.0	7.1 ± 6.0	6.25 ± 3.81	5.6 ± 4.4	6.4 ± 4.8
Maximum	11	24	17	18	24
Minimum	2	0	0	0	0
Solar radiation, W/m^2					
Mean	359.7 ± 341.9	272.8 ± 311.5	233.6 ± 301.7	211.7 ± 296.4	245.5 ± 305.2
Maximum	684	766	978	931	978
Minimum	0	0	0	0	0
CCI, C°[2]					
Mean	20.6 ± 9.4	23.6 ± 6.7	26.2 ± 6.5	26.2 ± 6.0	25.1 ± 6.7
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).