Effects of Limit Feeding and Shade on Growing Calf Performance, Water Usage, and Animal Comfort

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Introduction

- Heat stress abatement strategies may improve animal comfort and promote sustainability in the beef industry

- Our research group demonstrated improved feed efficiency when calves were limit-fed a high-energy diet compared with calves fed for *ad libitum* intake a high-roughage diet

- Panting scores are an established method used to measure animal comfort during heat stress events

- Previous research demonstrated shade reduced panting score severity in feedlot cattle

- To our knowledge, effects of limit-feeding a high-energy diet with shade on feed efficiency in stocker calves have not been investigated

- Limit feeding a high-energy diet with access to shade may increase feed efficiency, improve animal comfort, and reduce water usage
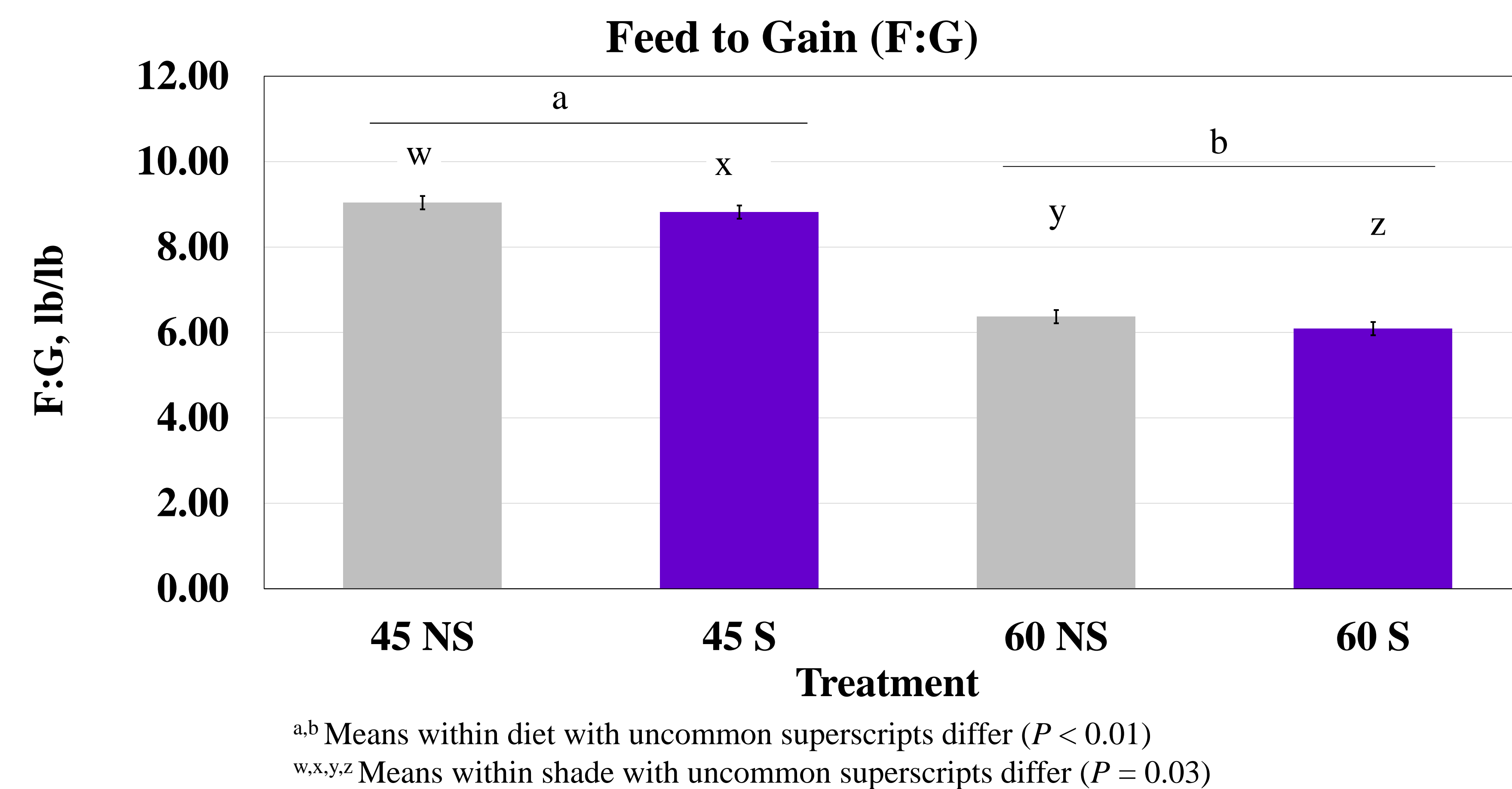
Objective

- Evaluate the impacts of limit feeding and shade access as possible strategies to improve cattle efficiency, reduce water usage, and improve animal comfort in growing cattle.
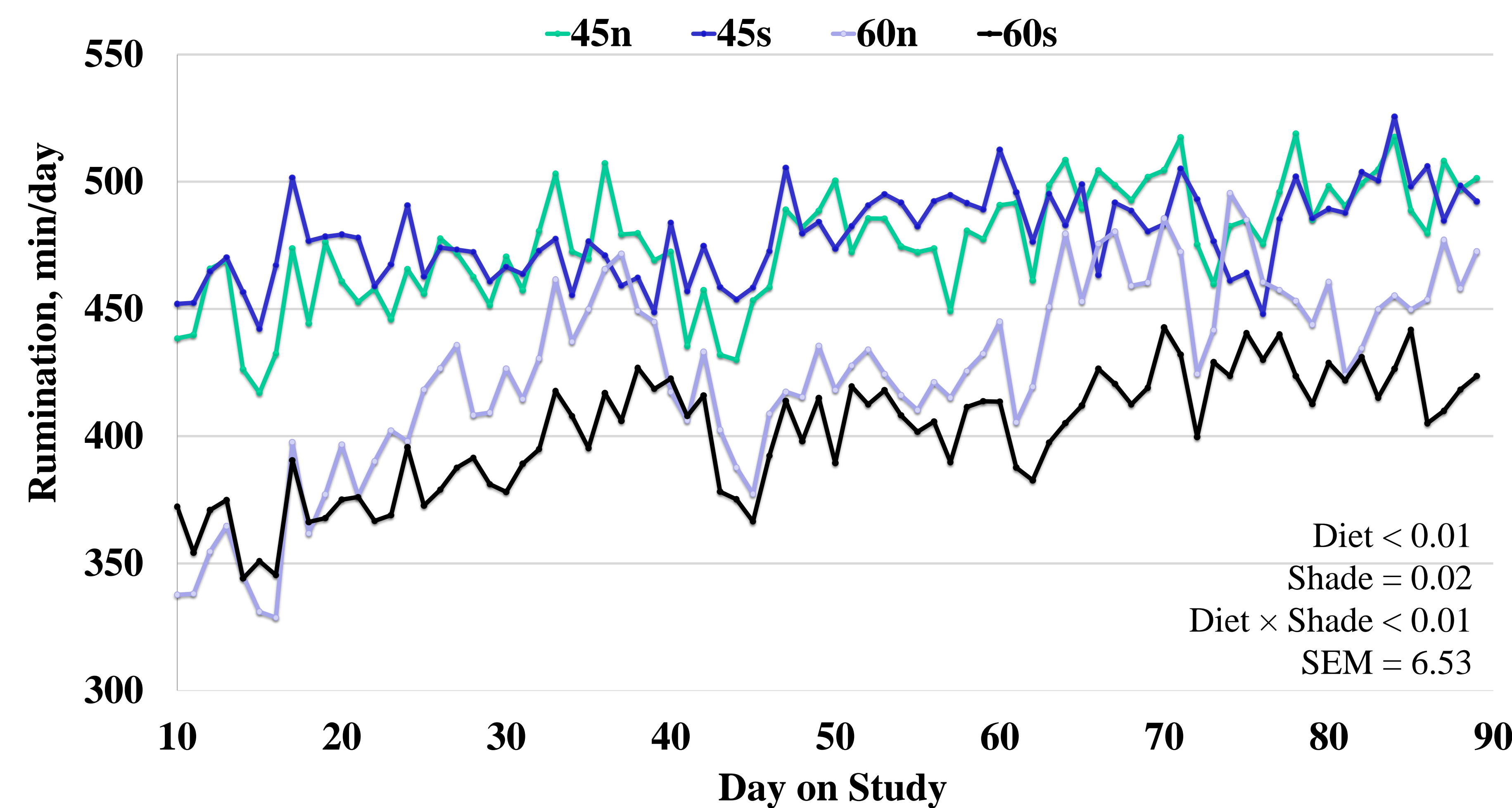
Materials and Methods

- A total of 852 predominately black-hided heifers (initial weight 553 ± 62 lb), purchased from Iowa, Kansas, and Missouri, were transported to the KSU Beef Stocker Unit in 2021 and 2022

- Calves were blocked by load and arranged in a 2×2 factorial design with calves fed a high-roughage diet at *ad libitum* intake (45) or limit-fed a high-energy diet (60) in shaded (S) or non-shaded (NS) pens

- Limit-fed cattle were fed 2.2% of body weight (BW) on a dry matter basis for 90 days

- Calves were fed a gut-fill (53) equilibration diet from day 90-97 at 2.5% body weight to equalize gastrointestinal tract fill

- Calves were fed once daily beginning at 7:00 am using a Roto-Mix feed wagon (Model 414-14B, Dodge City, KS)

- Bunks were observed prior to feeding and calves fed for *ad libitum* intake had refusals targeted at 5% dry matter of previous delivery.

- Three animals per pen were randomly selected at 09:30 am, 1:30 pm, and 5:30 pm to determine panting scores on days when temperature humidity index (THI) was > 74 based on U.S. MARC predictive heat stress system

- Water usage data were collected using iPERL systems attached to automatic waterers (SENSUS, Morrisville, NC)

- Shade structures provided 77 ± 6.3ft^2 of shade per animal (Strobel Manufacturing Inc. Clarks, NE)

- All data were analyzed using MIXED procedure in SAS (v9.4, SAS Institute In. Cary, NC)

- Performance and water usage model included fixed effects of shade, diet and shade × diet. Day served as the repeated measure for water usage data. Panting score data model included shade, hour, and shade × diet as fixed effects.

- Rumination data were recorded using a 3-axial accelerometer ear tags (Allflex Livestock Intelligence, Madison, WI) placed in calves on day 1 of study

Animal Performance

	Treatment					P-value		
	No Shade		Shade					
Item,	45	60	45	60	SEM	Diet	Shade	D × S
BW, lb								
day 0	563.5	564.3	560.5	562.8	2.06	0.46	0.28	0.72
day 90	811.7	807.9	825.7	814.1	4.61	0.10	0.04	0.40
day 97	808.2	834.0	818.3	837.0	4.85	<0.01	0.19	0.47
ADG, lb/d	2.25	2.39	2.44	2.53	0.057	<0.01	<0.01	0.47
DMI, lb/d								
0 to 90	20.14	14.84	21.45	14.92	0.274	<0.01	<0.01	<0.01
90 to 97	20.78	20.75	21.00	20.94	0.164	0.69	0.07	0.90
Water Usage, gal/day	11.9	10.8	10.6	9.8	0.28	<0.01	<0.01	0.13

Feed to Gain (F:G)

a,b Means within diet with uncommon superscripts differ ($P < 0.01$)
w,x,y,z Means within shade with uncommon superscripts differ ($P = 0.03$)

Rumination

Diet < 0.01
Shade = 0.02
Diet × Shade < 0.01
SEM = 6.53

Diet Composition

Ingredient, % DM	45	60	53
Cracked corn	8.6	38.8	23.8
Sweet Bran[1]	40.0	40.0	40.7
Alfalfa	22.5	6.5	14.2
Chopped prairie hay	22.5	6.5	14.4
Supplement[2]	6.4	8.2	6.9

[1] Cargill Corn Milling (Blair, NE)
[2] Supplement pellet formulated to contain (DM basis) 11.5% crude protein, 0.60% phosphorus, 4.7% salt, 0.80% potassium, 2.5% fat, and 307.2 g/ton monensin (Rumensin; Elanco, Greenfield, IN)

Animal Comfort

Score	Description
0	No panting. Respiration <60 breaths per minute
1.0	Slight panting, mouth closed, no drool, easy to see chest movement. Respiration ~60 to 90 breaths per minute
1.5	Moderate panting, no drool present, easy to see chest movement, mouth closed. Respiration ~60 to 90 breaths per minute
2.0	Fast Panting, drool present, mouth closed. Respiration ~90 to 120 breaths per minute
2.5	Fast Panting, drool present, occasional mouth panting. Respiration ~90 to 120 breaths per minute
3.0	Open mouth panting, excessive drooling, neck extended, head held up. Respiration ~120 to 150 breaths per minute
3.5	Open mouth panting, excessive drooling, tongue slightly extended or occasionally extended for short periods. Respiration ~120 to 150 breaths per minute
4.0	Open mouth with extended tongue for a prolonged period, excessive drooling, neck extended, and head up. Respiration ~120 to 150 breaths per minute
4.5	Open mouth panting, extended tongue, neck extended, head up, visible breaths from flank, drooling may be ceased. Respiration ~120 to 150 breaths per minute
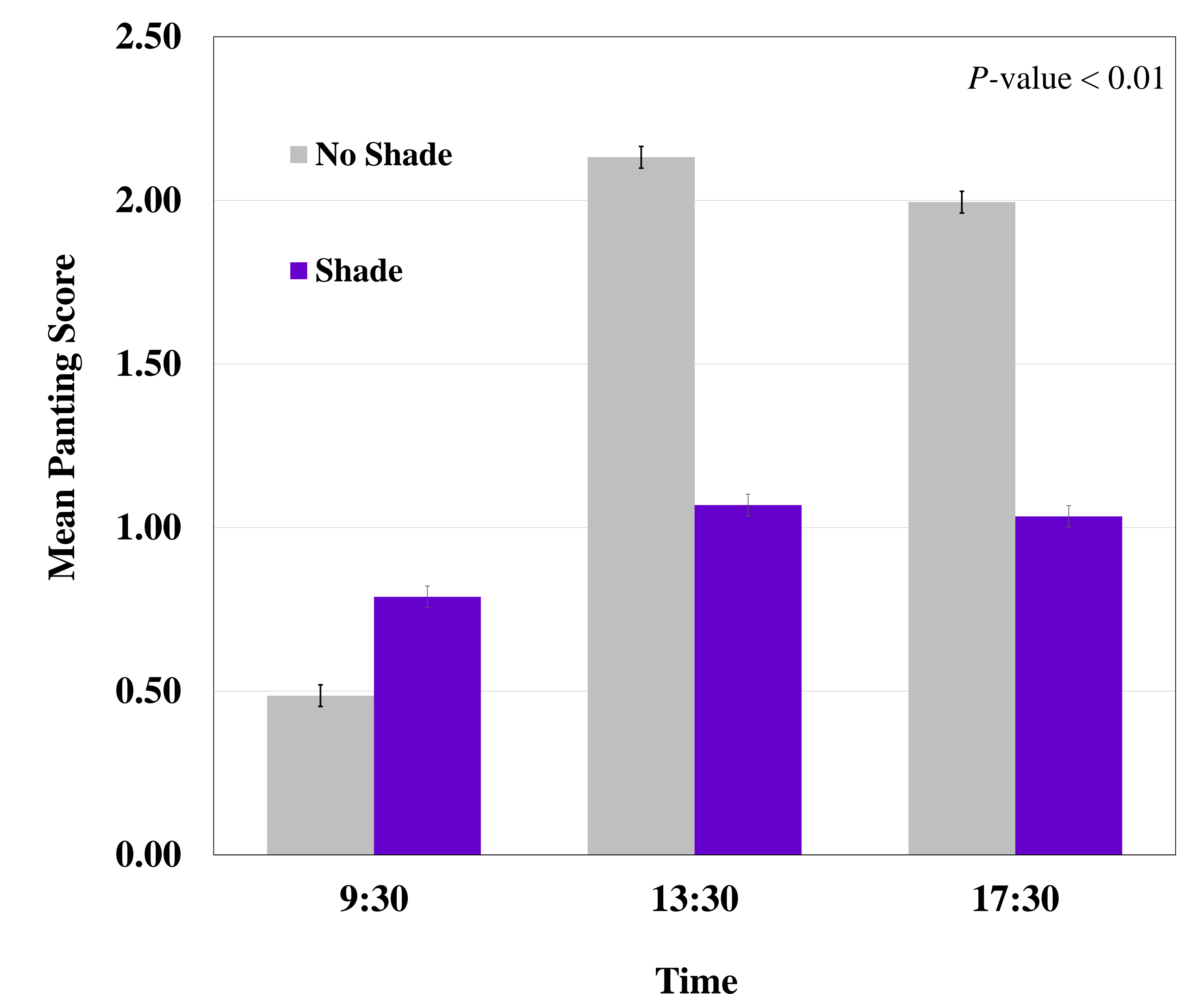
Conclusions

- Final body weights, following gut equilibration were greater for limit-fed calves compared with calves fed for *ad libitum* intake and greater for calves in shaded pens compared with calves in non-shaded pens

- Average daily gains were greater from d 0-97 for shaded calves compared with non-shaded calves

- F:G was lower in limit-fed calves compared with calves fed for *ad libitum* intake and calves in shaded pens compared with calves in non-shaded pens from d 0-97

- Daily rumination was less for limit-fed calves compared with calves fed for ad libitum intake

- Water usage was lower for limit-fed calves compared with calves fed for *ad libitum* intake and for calves provided shade when compared with calves in non-shaded pens

- Mean panting score was lower for calves in shaded pens compared with calves in non-shaded pens

- Stocker calf producers can potentially utilize shade in conjunction with limit-fed high energy diets to improve feed efficiency and decrease water usage

- In addition, shade can potentially be used in stocker calf operations to improve animal comfort