Impact of Shade in Beef Feedyards on Performance, Body Temperature, and Heat Stress Measures

Brett A. Melton
Bradley M. Boyd
Casey Macken
Andrea K. Watson
James C. MacDonald
Galen E. Erickson

Summary with Implications

A study using crossbred steers was conducted at a commercial feedyard to determine the effects of pen shades on cattle performance, body temperature, and cattle activity. Two heat events (Event 1 and Event 2) and one cool event were defined for the feeding period. No significant differences were observed for average daily gain, dry matter intake, feed to gain, or carcass characteristics at the end of the trial. During Event 1, cattle in pens with shade had lower panting scores than cattle in open pens. During Event 2, cattle in shade pens had greater dry matter intake, lower panting scores, and lower ear temperature. Throughout the entire feeding period, cattle in open pens had greater ear temperature and panting scores than cattle in shaded pens while movement was not different between treatments. Using shades for feedyard cattle did not impact performance, but did improve some measures of heat stress.

Introduction

Heat stress in beef feedyards has been shown to reduce feed intake, growth, efficiency, and in extreme cases result in death. One of the most commonly used practices for abating heat stress is the use of shades. Using shades in feed yard pens should increase feed intake and daily gain, improve carcass traits, and reduce the risk of death. The objective of this study was to determine the effect of shade on cattle performance, body temperature, and cattle activity.

Table 1. Composition of finishing diets

Ingredient, % DM	First diet (Fed from Start-July 2)	Second diet (Fed from July 3–Finish)
Dry rolled corn	35	41
Modified distillers grains	37	41
Wet Corn Gluten Feed (ADM)	10	10
Corn Silage	12	0
Corn Stalks (5 in grind)	2	3
Liquid Protein/Supplement[1]	4	5
Rumensin-90[2]	29.4 g/ton of DM	36.7 g/ton of DM
Tylan-40[3]	8.9 g/ton of DM	9.7 g/ton of DM

[1]Performance Plus Liquids (Palmer, NE)
[2]Rumensin (Elanco Animal Health; Greenfield, IN)
[3]Tylan (Elanco Animal Health)

Procedure

A study with crossbred steers (n = 1677; initial BW = 820 lb, SD = 104) was conducted at a commercial feedyard in Eastern NE to determine the effects of shade on cattle performance, panting scores, body temperature, and cattle activity. Cattle were received from March 17 to April 21. Upon arrival at the feedyard, cattle were weighed, given Titanium 5 (Elanco Animal Health; Greenfield, IN), injected with Ivermax Plus (Aspen Veterinary Resources; Greeley, Co), poured with Ivermax Pour On (Aspen Veterinary Resources; Greeley, Co), and implanted with Synovex Choice (Zoetis; Parsippany, New Jersey). Cattle were assigned to treatment as they exited the chute by switching a sort gate every third animal. Cattle were fed a common diet during the trial (Table 1). After the corn silage was depleted in the first diet, they were switched to the second diet on July 3. Cattle were re-implanted with Synovex Choice from June 7 to June 27 depending on start date and weight.

The experimental design was a randomized complete block with 2 treatments. Arrival date was used as the blocking effect. Ten pens were assigned randomly to a treatment as either having shade (SHADE) or no shade (OPEN) with 5 pens per treatment. Six of the pens were 200 by 400 feet and 4 of the pens were 135 by 400 feet. Each pen had approximately 420 ft^2/head. The shades in all the shaded pens were the same size, but number of animals per pen varied. Therefore, the larger pens supplied 30 ft^2/head and the smaller pens supplied 45 ft^2/head of shade.

A subset of 20 (4 smaller pens) or 30 (6 larger pens) steers from each pen were selected randomly based on processing order and given a Quantified Ag biometric sensing ear tag (Quantified Ag, Lincoln, NE). The tag recorded movement every hour and ear temperature 5 times every hour. The data were sent to an antenna located at the feed mill. The antenna was connected to the internet and to Quantified Ag's database. Panting scores were recorded by 1 trained technician on the same subset of animals that had the biometric sensing ear tag at least twice every week from June 8 to August 21 between 1300 and 1700 hours. Panting scores were based on a score of 0 to 4.0 in 0.5 increments with a score of 0 = no panting and 4.0 = open mouth with tongue fully extended, excessive drooling, and neck extended.

During the trial, 2 heat events were defined using wind adjusted temperature-humidity index (adjusted THI). The values used for adjusted THI were from a weather station located 1 mile south of the feedyard. The weather station recorded data every 30 minutes. Figure 1 shows the maximum,

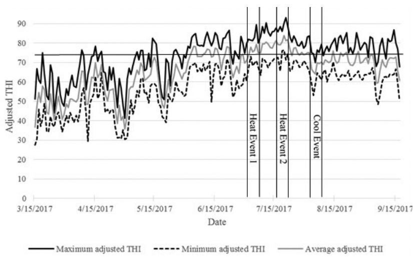

Figure 1. Maximum, minimum, and average adjusted temperature-humidity index (THI) across all days of the trial. The solid line shown at a THI of 74 represents the threshold set by the Livestock Weather Safety Index for heat stress in cattle. Heat Event 1 was from July 3 to July 7, Heat Event 2 from July 18 to July 22, and the Cool Event was from August 3 to August 7.

Table 2. Effect of shade in feedlot pens on performance of steers

	Treatments[1]			
Performance (Carcass Adjusted)	Open	Shade	SEM	*P*-Value
Initial BW, lb	825	824	2.1	0.75
Final Live BW, lb	1516	1521	5	0.47
Adjusted Final BW[2], lb	1472	1478	5	0.42
DMI, lb/d	24.6	24.8	0.15	0.31
ADG, lb/d	3.84	3.88	0.02	0.29
F:G[3]	6.40	6.40	–	0.85
Carcass characteristics				
HCW[4], lb	927	931	3.3	0.46
12th rib fat, in	0.60	0.61	0.02	0.49
Marbling score[5]	478	479	5.1	0.92
LM Area[6], in^2	14.3	14.5	0.1	0.24
Calculated YG[7]	3.42	3.43	0.05	0.92

[1]Treatments consisted of 5 open pens and 5 shaded (30 to 45 ft^2/animal) pens
[2]Adjusted Final body weight (BW) calculated from hot carcass weight (HCW) and a common 63% dressing percent
[3]Feed to Gain (F:G) was calculated and analyzed as Gain to Feed
[4]Hot carcass weight
[5]Marbling score: 300 = slight, 400 = small, 500 = modest, etc.
[6]LM area = longissimus muscle (ribeye) area
[7]Calculated Yield Grade (YG) = 2.50 + (2.5 × 12th rib fat, in)-(0.32 × LM area, in^2) + (0.2 × 2.5% KPH) + (0.0038 × HCW, lb)

minimum, and average adjusted THI throughout the trial. The Livestock Weather Safety Index uses an adjusted THI of 74 as the threshold for heat stress in cattle. The first heat event (Event 1) was from July 3 to July 7 and was the first 5 consecutive days in the feeding period with an average daily adjusted THI greater than 74. During Event 1 the daily maximum temperature averaged 86.7°F, daily minimum temperature averaged 66.6°F, maximum humidity averaged 92%, and maximum wind speed averaged 9.1 miles per hour (MPH) across the 5 days. The second heat event (Event 2) was from July 18 to July 22 and was the 5 consecutive days during the feeding period with the greatest adjusted THI. During Event 2 the daily maximum temperature averaged 90.9°F, daily minimum temperature averaged 72.6°F, maximum humidity averaged 92%, and maximum wind speed averaged 9.7 MPH across the 5 days. A cool event was also defined from August 3 to August 7 and was the first 5 consecutive days following the 2 heat events with an average daily adjusted THI less than 70. During the cool event the daily maximum temperature averaged 73.1°F, daily minimum temperature averaged 55.6°F, maximum humidity averaged 97%, and maximum wind speed averaged 7.2 MPH across the 5 days.

The first block of cattle was shipped on September 8 and the final block was shipped on September 20. Cattle were harvested at Cargill Meat Solutions (Schuyler, NE). Carcass characteristics and cattle performance were analyzed using the MIXED procedure of SAS (SAS Institute Inc. Cary, NC) with pen as the experimental unit. Panting scores and biometric sensing ear tag data were analyzed using the GLIMMIX procedure of SAS as repeated measures with pen as the experimental unit. Biometric sensing ear tag data were analyzed with a treatment by hour interaction sliced by hour (each hour of the day was analyzed together). For example, any recording from 0000 to 0100 hours would be analyzed together and be known as hour 0.

Results

There were no differences in SHADE cattle compared to OPEN cattle for dry matter intake (DMI), average daily gain (ADG), feed to gain (F:G) or carcass characteristics ($P \geq 0.24$; Table 2). Figure 2 shows the ear temperature of the cattle with the biometric sensing ear tag across all days of the trial (April 28 to September 8). Ear temperature had a treatment by hour interaction ($P < 0.01$) with OPEN cattle being significantly hotter than the SHADE cattle from 1300 to 1800 hours ($P \leq 0.05$), but not different during the other hours of the day. Movement was not significantly different between the OPEN and SHADE cattle ($P = 0.38$) across all days (Table 3). Panting scores were greater for OPEN cattle ($P < 0.01$) across all days of the trial.

During Event 1 there were no differences in DMI ($P = 0.32$) or ear temperature ($P = 0.24$) between treatments (Table 3). Panting scores were lower for SHADE cattle compared to OPEN cattle ($P < 0.01$). Event 2 was a more severe heat event compared to Event 1. During Event 2 the SHADE cattle had greater DMI compared to OPEN cattle ($P < 0.01$). Panting scores and ear temperature were lower for SHADE cattle than OPEN cattle ($P < 0.01$).

During both Event 1 and 2, movement had a treatment by hour interaction. During Event 1, SHADE cattle had greater movement than OPEN cattle ($P \leq 0.05$) at 1100 h and from 2000 to 2300 h. During Event 2, OPEN cattle had greater movement than SHADE cattle ($P \leq 0.05$) from 1300 to 1400 h, while SHADE cattle had greater movement than OPEN cattle from 1900 to 2000 h, and 2200 to 2300 h.

During the cool event, SHADE cattle still had slightly greater DMI compared to OPEN ($P < 0.01$; Table 3). Panting scores were the same for both treatments ($P = 0.99$), but very little panting occurred during this period. There were no treatment differences for ear temperature ($P = 0.11$) or movement ($P = 0.76$) during the cool event. The cool event showed that, under

Table 3. Main effect of treatment on dry matter intake (DMI) and heat stress measurements during the heat and cool events

	Treatments			*P*-Value		
Item	Open	Shade	SEM	Trt	Hour	Trt×Hour
Heat event 1 (July 3–July 7)[1]						
DMI, lb/d	26.4	26.6	0.44	0.32	-	-
Panting Score[2]	0.88	0.61	0.06	<0.01	-	-
Ear Temperature, °F[4]	100.6	100.4	0.1	0.24	<0.01	0.50
Heat event 2 (July 18–July 22)[1]						
DMI, lb/d	20.9	22.2	0.44	<0.01	-	-
Panting Score[2]	1.75	1.42	0.07	<0.01	-	-
Ear Temperature,°F[4]	100.8	100.4	0.1	<0.01	<0.01	0.28
Cool Event (August 3–August 7)						
DMI, lb/d	25.7	26.4	0.22	<0.01	-	-
Panting Score[2]	0.00	0.00	0.00	0.99	-	-
Movement[3]	30248	30593	1595	0.76	<0.01	0.96
Ear Temperature, °F[4]	98.1	97.7	0.1	0.11	<0.01	0.99
All days of the trial[1]						
Panting Score	0.74	0.55	0.02	<0.01	-	-
Movement	29032	29827	636	0.38	<0.01	0.99

[1] Movement from Heat Event 1 and Heat Event 2 are not shown in this table due to the treatment by hour interaction. These interactions are shown in Figures 3 and 4. Ear temperature across the entire trial also had a treatment by hour interaction and is shown in Figure 2.

[2] Panting Scores were based on a score of 0 to 4.0 in 0.5 increments

[3] Movement was measured using a biometric sense tag (Quantified Ag, Lincoln, NE) that measured total movement as well as velocity of that movement in a 3-dimensional space (n = 131 SHADE; n = 130 OPEN)

[4] Ear Temperature was measured using a biometric sense tag (Quantified Ag, Lincoln, NE; n = 131 SHADE; n = 130 OPEN)

thermoneutral conditions, SHADE cattle behave the same and have the same body temperature as OPEN cattle.

Conclusion

The use of shades in feedyards can decrease heat stress and minimize potential death loss of cattle on feed. This is evident from the greater DMI, lower panting scores, and lower ear temperature of SHADE cattle compared to OPEN during Event 2. Using shades for feedyard cattle did not impact performance over the entire feeding period, but did improve some measures of heat stress.

Brett A. Melton, graduate student

Bradley M. Boyd, research technician

Casey Macken, Performance Plus Liquids, Palmer, NE

Andrea K. Watson, research assistant professor

James C. MacDonald, associate professor

Galen E. Erickson, professor, University of Nebraska–Lincoln Department of Animal Science, Lincoln, NE

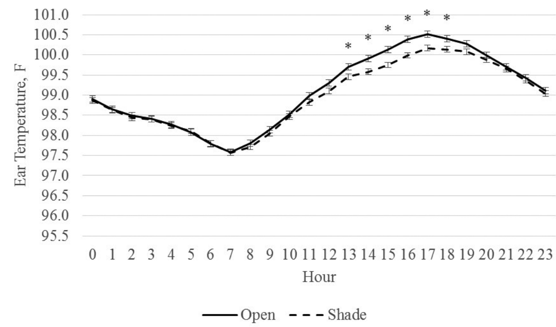

Figure 2. Effect of treatment (SHADE or OPEN) on ear temperature of cattle (n = 131 SHADE; 130 OPEN) during the entire trial. Ear temperature was measured using a biometric sense tag (Quantified Ag, Lincoln, NE). The interaction between treatment and hour was significant ($P < 0.01$). Treatment differences are significant ($P < 0.05$) at time points in the figure denoted with an *.

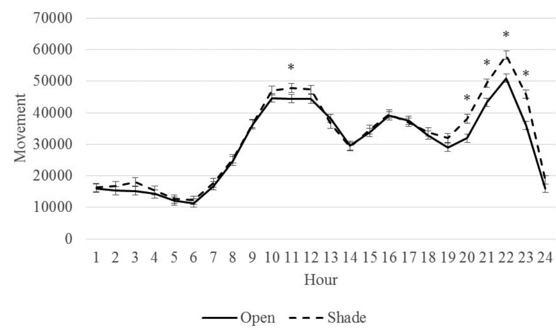

Figure 3. Effect of treatment (SHADE or OPEN) on movement of cattle (n = 131 SHADE; 130 OPEN) during Heat Event 1 (July 3 to July 7). Movement was measured using a biometric sense tag (Quantified Ag, Lincoln, NE) that measured total movement as well as velocity of the movement in a 3-dimensional space. The interaction between treatment and hour was significant ($P < 0.01$). Treatment differences are significant ($P < 0.05$) at time points in the figure denoted with an *.

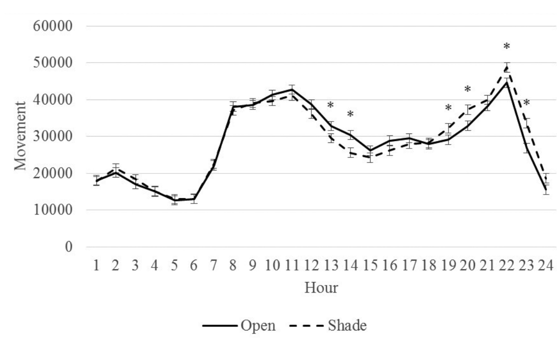

Figure 4. Effect of treatment (SHADE or OPEN) on movement of cattle (n = 131 SHADE; 130 OPEN) during Heat Event 2 (July 18 to July 22). Movement was measured using a biometric sense tag (Quantified Ag, Lincoln, NE) that measured total movement as well as velocity of the movement in a 3-dimensional space. The interaction between treatment and hour was significant ($P < 0.01$). Treatment differences are significant ($P < 0.05$) at time points in the figure denoted with an *.