Impact of Shade in Beef Feed Yards on Performance, Body Temperature, and Heat Stress

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Summary with Implications

A study using crossbred steers was conducted at a commercial feedyard in Eastern NE to determine the effects of shade on cattle performance, ear temperature, panting scores, and cattle activity. Cattle with shade had greater dry matter intake, average daily gain and lower panting scores while movement and ear temperature were not different between treatments. Over the course of the experiment three weather events were selected to be analyzed separately (two heat events and one cool event) based on wind adjusted temperature-humidity index. Providing shade during heat event 1 resulted in greater intakes and lower panting scores, while providing shade during heat event 2 resulted in lower panting scores compared to non-shaded cattle. During the cool event, greater intakes and lower panting scores were observed for shaded cattle, although panting scores were low for both treatments. Providing shade for cattle improved intakes and average daily gains while mitigating some effects of heat stress.

Introduction

Heat stress in cattle is a concern to both the animal as well as the producer. Heat stress costs the beef industry millions of dollars annually in production losses ranging from decreases in gain to increased death loss. With potential for reduced performance paired with consumer concerns with animal welfare, cattle comfort should be considered. Providing shade to cattle in feedyards will: decrease solar radiation experienced by the animal, and reduce ground temperature, but will have little to no effect on ambient air temperature. The effect of shade on cattle performance depends on location (humid vs dry climate for example), weather (year to year variation), area under the shade (crowding/mud concerns), cattle behavior, among other factors. The objective of this study was to determine the effect of shade on cattle performance, ear temperature, and cattle activity and was the second year of a two-year study. This trial was designed similarly to the year 1 study (*2019 Nebraska Beef Cattle Report*, pp. 85–87) with the main difference being an earlier slaughter date to avoid a cool period that potentially allows for non-shaded cattle to compensate prior to shipping.

Procedure

A study with crossbred steers (n = 1713; initial BW = 834 lb, SD = 23) was conducted at a commercial feedyard in Eastern NE exploring the effects of providing shade to cattle.Cattle were received from February 19 to March 5. Upon arrival 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 consisting of 63% dry-rolled corn, 20% modified distillers grains plus solubles, 8% corn cobs, 5% wet corn gluten feed, and 5% supplement containing 36.6 g/ton Rumensin, and 9.6 g/ton Tylan (DM-Basis) . Cattle were weighed and re-implanted from May 3 to May 31 depending on receiving date.

The experimental design was a randomized complete block with two treatments and arrival date used as the blocking effect (n=5). Ten pens were assigned randomly to treatment as either having shade (SHADE) or no shade (NO SHADE) provided in the pens, with five pens per treatment. Six of the pens were 200 by 400 feet and 4 of the pens were 135 by 400 feet. The shades were all the same size and are composed of high-density polyethylene monofilament (NetPro; Stanthorpe Qld, Australia) that excludes 70% of sunlight. Cables that run the length and width of pen held the shade 18 feet above pen surface. Given that shade sizes were the same across all pens, then three large and two small pens had shade while 3 large and two small pens did not have shade. Each pen provided 420 ft^2/steer, and shaded large pens provided 30 ft^2/steer of shade while shaded small pens provided 45 ft^2/steer of shade.

A subset of 30 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 per hour. One trained technician recorded panting scores on the same subset of animals that had the biometric sensing ear tag at least twice every week from May 29 to July 24 between 1 pm and 5 pm. Panting scores were based on a score of 0 to 4.5 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.

The adjusted temperature-humidity index (adjusted THI) values came from a weather station located at the feed yard. Figure 1 shows the maximum, minimum and average adjusted THI throughout the trial as well as three weather events. The Livestock Weather Safety Index uses an adjusted THI of 74 as the threshold for heat stress in cattle. Heat event 1 was from May 24 to June 1, and heat event 2 was from July 9 to July 16. Both events had a maximum THI greater than 74 each day, with multiple days being greater than 80. The cool event was from June 2 to June 7 and was the first five consecutive days following a heat event with an average daily adjusted THI less than 74.

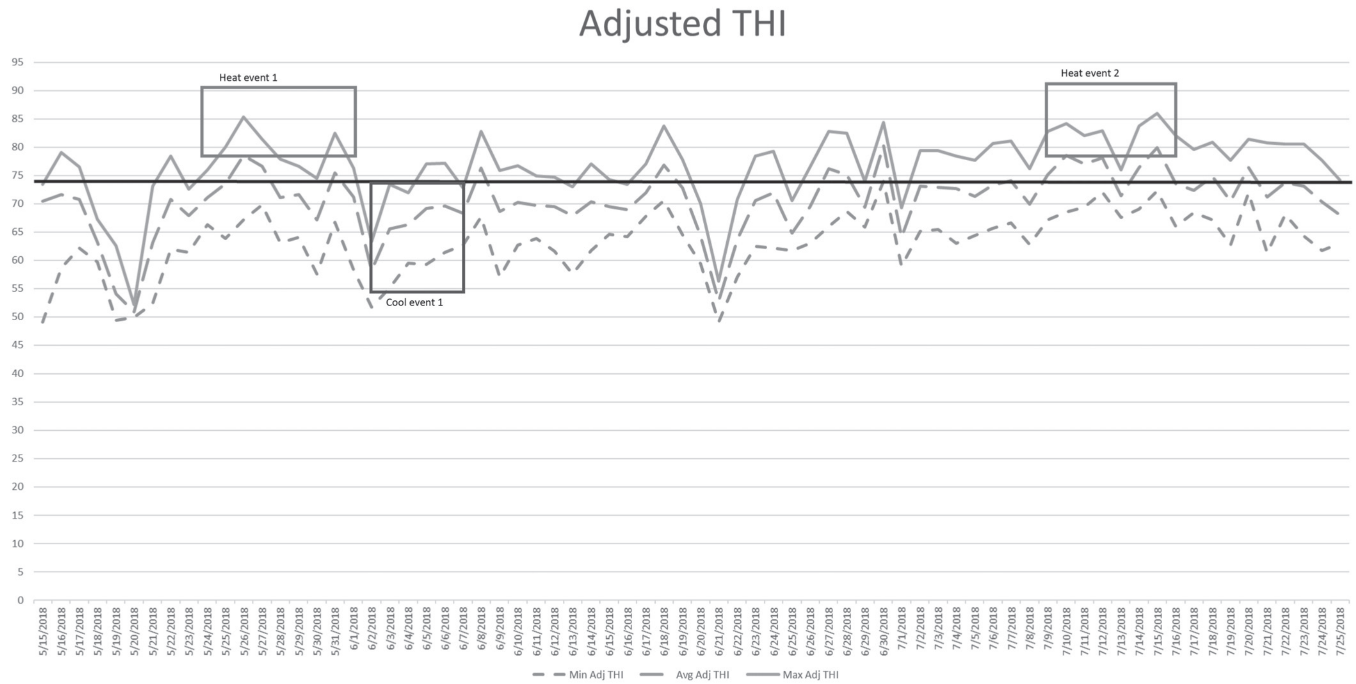

Figure 1. Maximum, minimum, and average adjusted temperature-humidity index (THI) across all days of the trial. The solid line shown at a THI of 74 represents the threshold set by the Livestock Weather Safety Index for heat stress in cattle. Heat event 1 was from May 24 to June 1, cool event 1 was from June 2 to June 7, and heat event 2 was from July 9 to July 16.

Table 1. No shade vs. Shade performance and carcass traits

	Treatments[1]			
Item	No Shade	Shade	SEM	*P*-value
Performance				
Initial BW, lb	835	833	3	0.65
Adjusted Final BW[2], lb	1462	1479	6	0.11
DMI, lb/d	22.9	23.4	0.02	< 0.01
ADG, lb	3.90	4.02	0.03	0.04
F:G	5.87	5.81	0.05	0.47
Carcass				
HCW[3], lb	921	932	4	0.12
LM area[4], in^2	14.1	14.7	0.2	0.06
12th rib fat, in	0.59	0.61	0.01	0.32
Marbling[5]	460	459	4	0.87
Calculated YG[6]	3.42	3.31	0.07	0.32

[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]Hot carcass weight

[4]Marbling score: 300 = slight, 400 = small, 500 = modest, etc.

[5]LM area = longissimus muscle (ribeye) area

[6]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)

The first block of cattle was shipped on July 25 and the final block was shipped on August 27. Cattle were harvested at Cargill Meat Solutions (Schuyler, NE). Carcass characteristics, cattle performance, panting scores, and biometric ear tag data 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 as repeated measures, and biometric sensing ear tag data were tested by pen for treatment by hour interactions.

Results

SHADE cattle had greater DMI and average daily gain (ADG) across the feeding period compared to NO SHADE cattle ($P \leq 0.04$), while feed conversion was not impacted ($P = 0.47$; Table 1). Ribeye area tended to increase ($P = 0.06$) while final BW and hot carcass weight (HCW) were numerically greater ($P \leq 0.12$) for SHADE cattle compared to NO SHADE cattle. Ear temperature tended to be greater ($P = 0.08$; Table 2) for SHADE cattle while movement (Figure 2) was not different ($P = 0.31$) between treatments across the entire feeding

Table 2. Main effect of treatment on DMI, panting score, movement, and temperature during weather events

Item	Treatment		SEM	*P*-Value		
	No Shade	Shade		Trt	Hour	Trt*Hour
Total Trial[1]						
Movement	28,858	28,804	395	0.93	< 0.01	0.99
Temperature, °F[2]	97.91	97.96	0.12	0.80	< 0.01	0.31
Panting Score[3]	0.98	0.70	0.02	< 0.01	-	-
Heat Event 1[4]						
Panting Score	0.70	0.27	0.06	< 0.01	-	-
DMI, lb/d	20.0	24.0	0.5	< 0.01	-	-
Cool Event[5]						
Movement	31,694	31,846	472	0.83	< 0.01	0.32
Temperature, °F	98.20	98.54	0.15	0.08	< 0.01	0.27
Panting Score	0.42	0.26	0.04	0.01	-	-
DMI, lb/d	21.6	23.4	0.1	< 0.01	-	-
Heat Event 2[6]						
Panting Score	1.76	1.45	0.05	< 0.01	-	-
DMI, lb/d	22.7	23.3	0.3	0.14	-	-

[1]February 26–July 25

[2]Ear temperature was measured using a biometric sense tag (Quantified Ag, Lincoln, NE)

[3]Panting scores were based on a score of 0 to 4.5 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

[4]May 25–June 1

[5]June 2–June 7

[6]July 7–July 16

period. Figure 3 shows cattle movement during heat event 1 where a treatment by hour interaction was observed. NO SHADE cattle moved more from 11 am to 5 pm, and SHADE cattle moved more from 8–9 pm ($P < 0.05$). Figure 4 shows cattle movement during heat event 2 where SHADE cattle moved more from 5–8 pm plus hour 11 pm compared to NO SHADE cattle ($P < 0.05$). Figure 5 shows cattle ear temperature during heat event 1 where a treatment by hour interaction was observed ($P < 0.01$). SHADE cattle had greater temperature from 12–8 am while NO SHADE had greater temperature from 2–8 pm ($P < 0.05$). Figure 6 shows cattle ear temperature during heat event 2 where a treatment by hour interaction was observed ($P = 0.10$). NO SHADE cattle had greater temperature at 3, 5, and 7 pm compared to SHADE cattle ($P < 0.05$). Panting scores were greater for NO SHADE cattle compared to SHADE cattle across the entire feeding period, as well as within both heat events and the cool event ($P \leq 0.01$; Table 2). Dry matter intake was greater during heat event 1 and the cool event ($P \leq 0.01$), while DMI was numerically increased during heat event 2 ($P = 0.14$) for SHADE compared to NO SHADE for cattle experiencing heat events close to slaughter. No differences in performance were detected in year 1, likely due to later slaughter date paired with cooler weather at the end of the feeding period. These results are similar to what was observed in year one for cattle movement as both years suggest shade cattle move at different times of the day compared to no shade during heat events as well as greater panting scores for non-shaded cattle across the entire feeding period both years. One main difference between year 1 and 2 is the difference in intake that was observed in year two was not found in year one. This is a result of multiple factors, including a cool August in year one that potentially allowed the non-shaded cattle to experience compensatory gain.

Conclusion

Cattle provided shade had greater DMI and ADG while having numerically greater final BW and HCW, along with reduced panting scores compared to cattle without access to shade. The greater ADG and subsequent numerically greater final BW and HCW are likely driven by better intakes during heat events. No differences in movement or ear temperature were observed across the entire feeding period. Some differences occurred between treatments within heat events, illustrating that cattle provided shade move at different times of the day while overall movement is not impacted.

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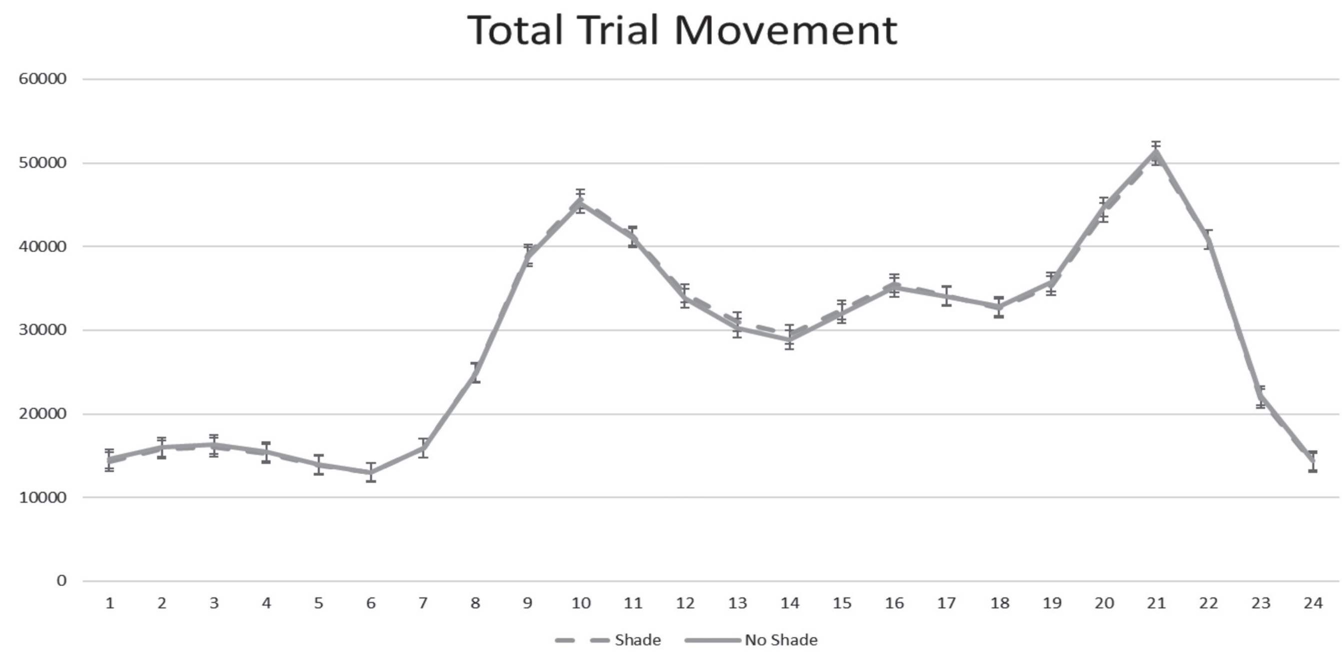

Figure 2. Effect of treatment (SHADE or NO SHADE) on movement of cattle across entire feeding period. Movement was measured using a biometric sense tag (Quantified Ag, Lincoln, NE) that measured total movement.

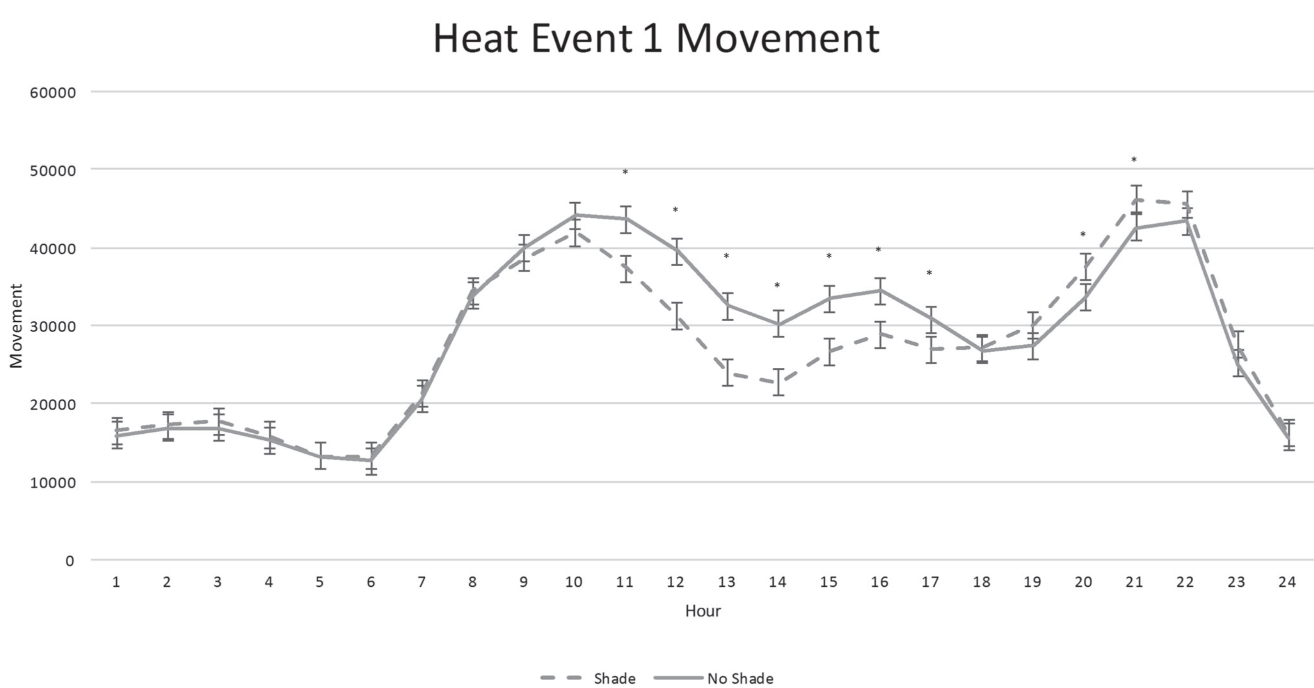

Figure 3. Effect of treatment (SHADE or NO SHADE) on movement of cattle during Heat Event 1 (May 24—June 1). Movement was measured using a biometric sense tag (Quantified Ag, Lincoln, NE) that measured total movement. The interaction between treatment and hour was significant ($P < 0.01$). Treatment difference within hour are significant ($P < 0.05$) at time points denoted with an *.

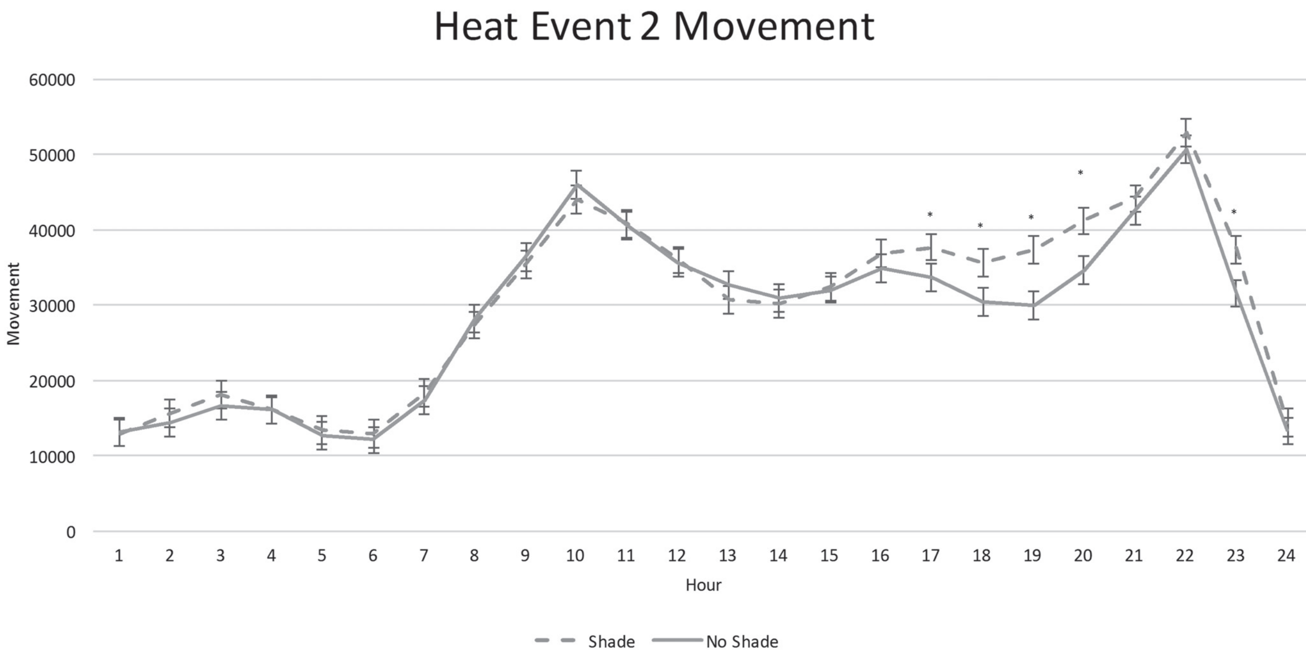

Figure 4. Effect of treatment (SHADE or NO SHADE) on movement of cattle during Heat Event 2 (July 9—July 16). Movement was measured using a biometric sense tag (Quantified Ag, Lincoln, NE) that measured total movement. The interaction between treatment and hour was significant ($P = 0.06$). Treatment difference within hour are significant ($P < 0.05$)at time points denoted with an *.

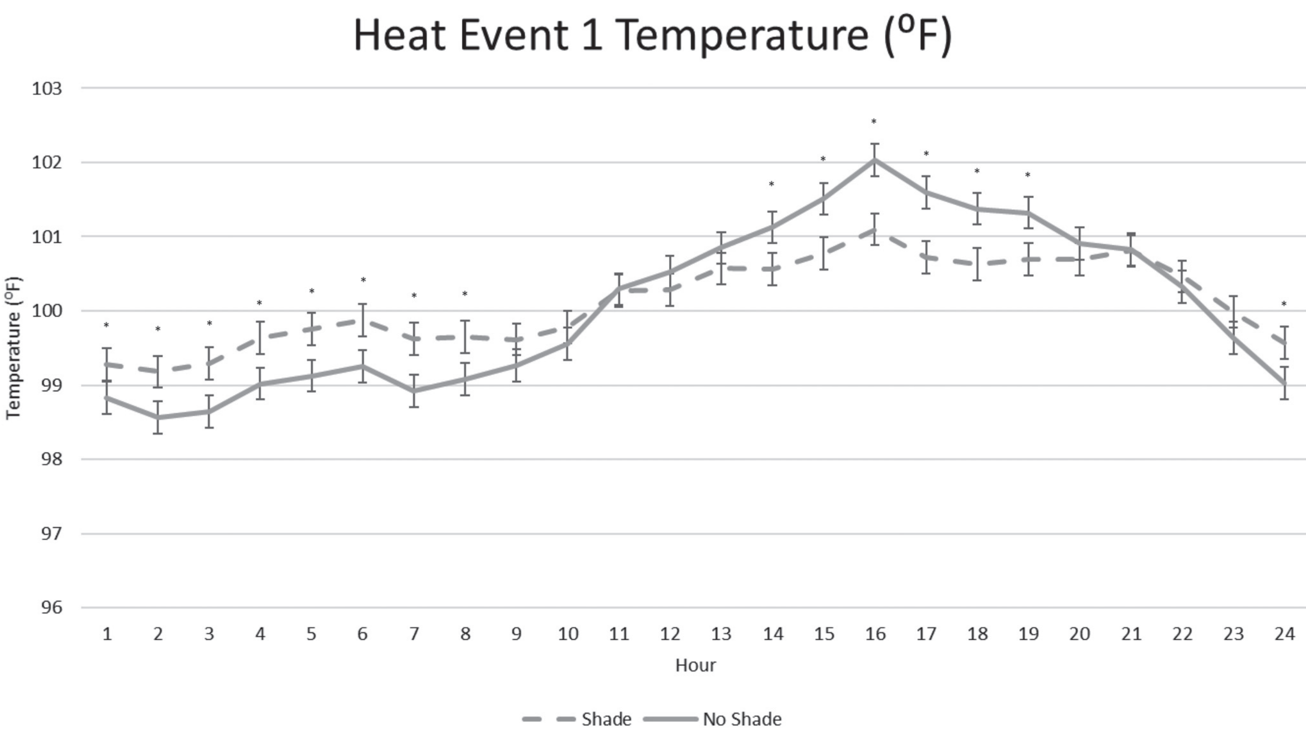

Figure 5. Effect of treatment (SHADE or NO SHADE) on ear temperature of cattle during Heat Event 1 (May 24—June 1). Temperature was measured using a biometric sense tag (Quantified Ag, Lincoln, NE) that measured ear canal temperature. The interaction between treatment and hour was significant ($P < 0.01$). Treatment difference within hour are significant ($P < 0.05$) at time points denoted with an *.

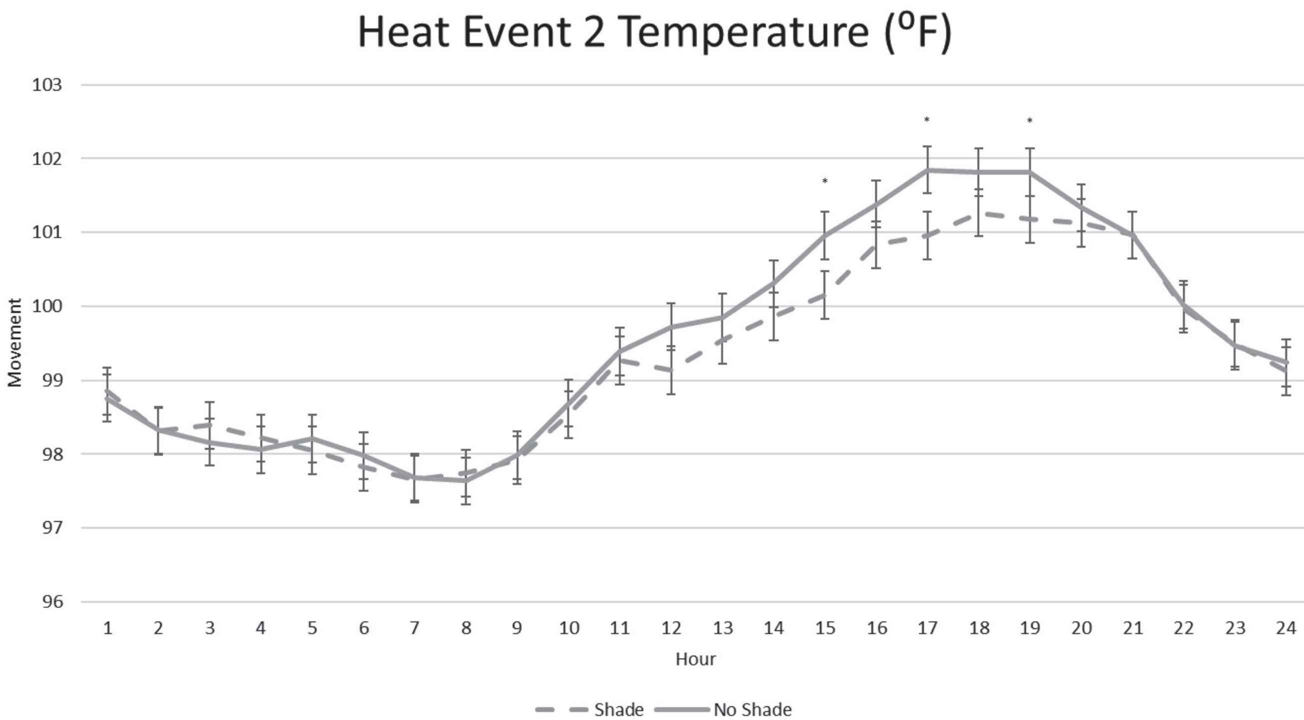

Figure 6. Effect of treatment (SHADE or NO SHADE) on ear temperature of cattle during Heat Event 2 (July 9—July 16). Temperature was measured using a biometric sense tag (Quantified Ag, Lincoln, NE) that measured ear canal temperature. The interaction between treatment and hour was significant ($P = 0.10$). Treatment difference within hour are significant ($P < 0.05$) at time points denoted with an *.