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Effects of shade on heifers evaluated

Bottom Line

with
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TOO often, I have seen Holstein heifers be subjected to no shade during hot summer months, especially in the western U.S.

A historical perspective on heat stress in heifers was presented by Armstrong (2009) at the annual Dairy Calf & Heifer Conference in Tucson, Ariz., in March. At about the same time, a new study was published exploring this topic (Marcillac-Embertson et al., 2009).

Armstrong listed thermoneutral zones for heifers as follows: 59-79°F for calves one to two weeks old, 64-79°F for calves one month old and 50-72°F for heifers growing at 1.5 lb. per day.

Factors affecting the thermoneutral zone of a dairy heifer include: body condition of the animal, feed intake, hair coat from summer to winter, time after feeding, temperature/humidity/wind speed, moisture as rain or snow and shelter provided (radiation).

What many calf/heifer growers do not realize is the effect the lack of shade can have because these animals are not producing milk, and there generally are no measures of their performance (intake, daily gain, height increase, etc.).

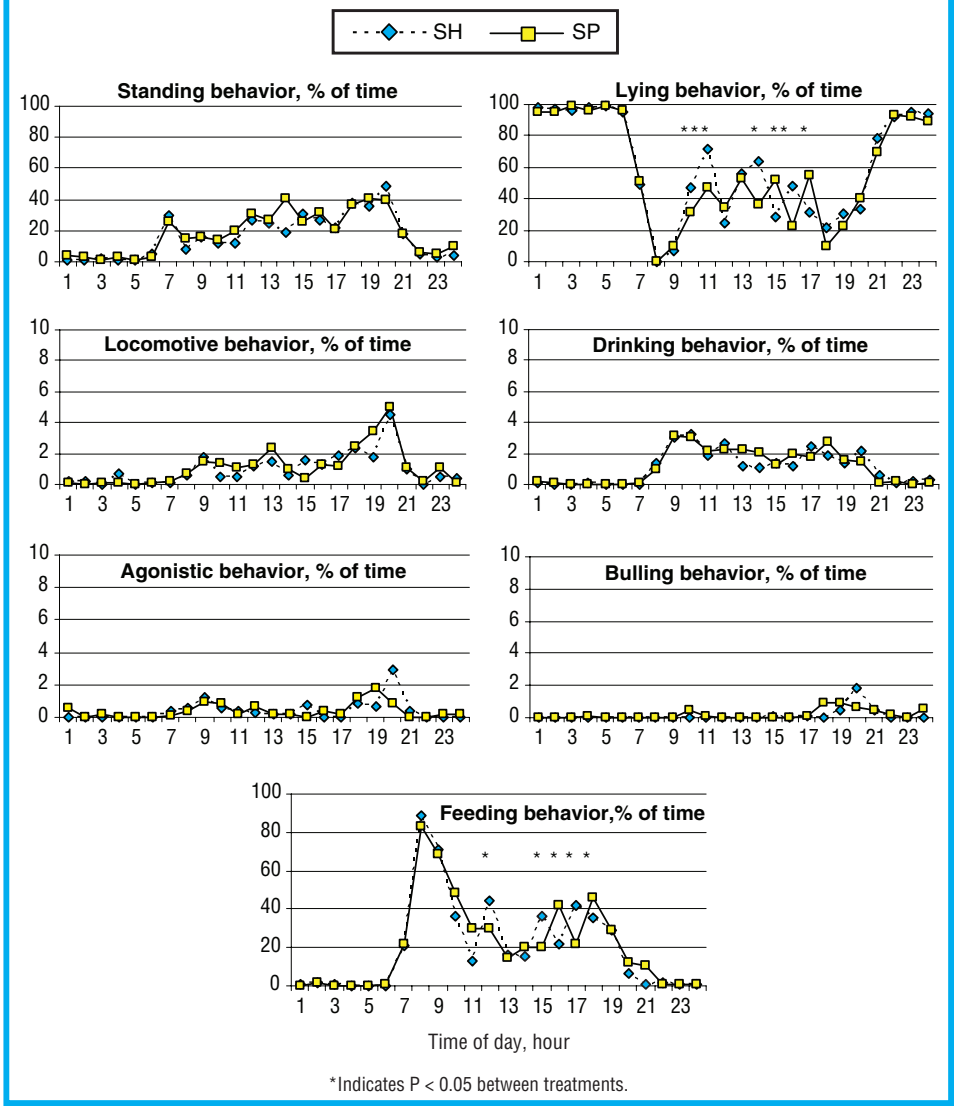
Additionally, lack of shade can have the greatest effect on the smallest calves/heifers because they have the greatest surface:body mass ratio, which decreases as body mass increases. Also, the more "black" Holstein heifers are, the more they will be subjected to heat stress. (Put your hand on a black vehicle on a hot, sunny day — if you can.)

In the Marcillac-Embertson et al. study, 40 Holstein heifers were used in a trial during July to October 2003 at the University of California-Davis. These animals averaged 656 lb. in initial bodyweight and were randomly divided into four groups for the entire study.

They were fed a total mixed ration once daily at 0600 hours, and feed was adjusted daily for 10% refusals. The ration was 51.4% alfalfa hay, 29.9% oat hay, 17.6% almond hulls and 1.1% mineral mix for a dry matter of 87.6% with 13.1% crude protein.

Four dirt floor drylot corrals were oriented west (front) to east (back) with a 33 ft. feed bunk at the front containing 14 head locks. There was a 4.27 ft. feed apron on the front and a 3% slope of the dirt floor to allow for water runoff. A float-activated water trough was located along

Behavior over time of heifers housed in either shaded (SH) or sprinkled (SP) corrals. Behaviors are reported as percentages of time over a 24-hour period



*Indicates P < 0.05 between treatments.

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the south side of each corral. The corrals were separated from each other by a 41 ft.-wide, unoccupied dirt surface.

Treatments were shade (no sprinklers) or sprinklers (no shade). Each treatment period was 21 days long, divided into a 14-day adaptation period followed by a seven-day sampling period. Shades and sprinklers were moved for each treatment period rather than having the heifers moved among corrals.

Shades were solid tin sheets at 15 ft. tall, and the shaded area was 70 sq. ft. per heifer. The north-to-south oriented shades caused the shade and manure deposition to move throughout the day.

Sprinklers were mounted at the water trough and had a 180º sprinkling pattern. The spray was 7.9 ft. above the surface and had a 31.8 ft. radius.

Sprinklers were activated for seven minutes each at 1100, 1300, 1500, 1700 and 1900 hours. This pattern was similar to the standard practice in California and maximized the water application to the corral surface without causing excessive water pooling in the corral.

On day 21, heifers were weighed, corrals were scraped to remove manure and corrals were unoccupied for a three-day period.

Physiological measurements were made on four of 10 heifers in each corral on day 15 at 1030 and 1700 hours. These measurements included respiration rate and rectal temperature; blood, urine and fecal samples were taken while heifers were headlocked.

Behavioral measurements were made on day 14 over a 24-hour period. These observations were made from a 15 ft. tower starting at 0400 hours using a five-minute sampling technique. Observations with the corral divided into eight sections included defecation, urination, locomotion, feeding bouts, drinking, lying, standing, mounting and agonistic behaviors.

An automated weather station at the east end of the corrals recorded daily measurements. Air particulate matter was measured with samplers enclosed and mounted 6.6 ft. above the surface at the center of corrals. Ground surface temperature and moisture were recorded on day 20 of each treatment period for each corral.

Animal performance, physiological responses and environmental measurements

	Shade	Sprinklers	P <
Daily gain, lb./day	2.97	2.55	0.001
DMI, lb./day	21.6	20.9	0.03
Feed:gain	7.42	8.52	0.002
Rectal temperature, °F			
1030 hours	102.4	102.4	0.788
1700 hours	103.3	103.3	0.138
Respiration rate per minute	75.5	87.0	0.002
Blood urea nitrogen, mg/dL	10.7	10.9	0.691
Urine urea nitrogen, mg/dL	370.6	390.9	0.666
Particulate matter, mg/cu. m			
Smaller than 2.5 µm	0.034	0.034	0.839
Smaller than 10.0 µm	0.061	0.046	0.015
Ammonia concentration, µg/cu. m	119.3	222.4	0.038
Mean ground surface moisture, %	11.2	16.2	0.002

Heifers had high dry matter intakes (DMI) and high daily gains (Table), with shaded heifers having increased ($P < 0.03$ to 0.001) DMI, daily gain and feed efficiency. Intakes and daily gains were high, but the authors informed me that these were true numbers. This is an indication of how heifers fed free choice, even with high-forage rations, can exceed the approximate 2 lb. daily gain preferred to avoid fattening. I will expand on this in a future column.

Shade increased ($P < 0.03$ to 0.001) daily gain, DMI and feed efficiency versus the sprinkler treatment. Rectal temperatures, blood urea nitrogen and urine urea nitrogen did not differ between treatments, but respiration rate was greater ($P < 0.002$) for the sprinkler versus shade treatment.

Larger particulate matter was lower ($P < 0.015$) for the sprinkler versus shade treatment, perhaps because the wetter ($P < 0.002$) ground limited larger particles from becoming airborne. However, ammonia concentration was greater ($P < 0.038$) for the sprinkler treatment, perhaps due to the greater ground moisture.

Relative humidity averaged 22% during the daytime and 78% at night. Ground surface temperatures were 31% lower ($P < 0.05$) in shaded areas and 21% lower ($P < 0.001$) in sprinkled corrals.

It was also observed that heifers lay down in the outer range of the sprinkler radius (moisture of 8-10%) rather than within the radius, where moisture averaged 20-26%. Behaviors of heifers throughout the day are shown in the Figure.

Other observations noted were that all heifers concentrated their elimination behaviors at the front of the corral, where the feed bunk was and where they rested at night, and avoided the back unshaded portion of the corral until the evening.

The Bottom Line

Shading versus sprinkling of corrals had positive effects on daily gain, DMI and feed efficiency of Holstein heifers, while sprinkled heifers had greater respiration rates. Shade for heifers is too often ignored because measurements are not made, such as in this study, that show the beneficial effects of shading.

References

Armstrong, D.V. 2009 The effect of heat stress on dairy heifers. Proc. 13th DCHA Dairy Calf & Heifer Conf. p. 219-228. Tucson, Ariz.

Marcillac-Embertson, N.M., P.H. Robinson, J.G. Fadel and F.M. Mitloehner. 2009. Effects of shade and sprinklers on performance, behavior, physiology and the environment of heifers. J. Dairy Sci. 92:506-517. ■