



Beat *the* Heat

Be observant for symptoms of heat stress and take steps to minimize production losses associated with overheating.

Story by

HEATHER SMITH THOMAS

Hot weather can be hard on cattle, especially when humidity is high, says Don Spiers, associate professor of animal sciences at the University of Missouri-Columbia. Cattlemen need to be prepared to minimize heat stress, which can interfere with weight gain and reproduction and, when extreme, may be life-threatening.

The upper limit of the temperature comfort zone for cattle is about 75° F, Spiers says, but that threshold may vary, depending on how large the animal is and its color. Other contributing factors can also add to the risk of heat stress.

Dark skin. "If an animal is dark-skinned, chances of heat stress are much greater," Spiers says. Studies have shown that about 70% of feedlot deaths due to intense heat occur in animals with dark hides. The body temperatures of animals with black

hides are elevated (up to 104°) compared to those of light-colored cattle (usually 101°-102°, which is normal) during hot weather.

Cattle can have heart failure if body temperatures reach 107°, Spiers warns.

Bulky muscle. Cattle with lots of muscle mass generate more body heat than cattle with less muscle. The bulky muscles have more heat to disperse.

"People tend to think cattle are hottest during midday when air temperature is highest, but there's actually a delay of several hours," Spiers explains.

Cattle are so large that they have more trouble dissipating heat than do humans, so they have a slow rise in body temperature as they accumulate heat.

Metabolic heat load. After cattle eat, there's an increase in metabolic heat produced. "They don't reach the peak until four to five hours after they finish eating," he says. Feeding

cattle before 8 a.m. or after 5 p.m. can help by timing the metabolic heat load to occur when it's cooler. "Then they can dissipate it better and get rid of it."

Cattle will eat more in the cooler parts of the day, Spiers says. "They don't like to eat when it's hot." Cattle on pasture will graze in early morning or late evening, resting during the heat of the day.

Lactation. "If a cow is lactating, her metabolism is higher. An animal producing a lot of milk is at greater risk of heat stress," he says. "The 75° comfort level assumes the animal is not lactating."

Rapid growth. "The upper level for comfort zone gets lower for the high-producing animal, whether lactating or rapidly growing," he continues. "An animal bred for rapid growth is also producing a lot of metabolic heat." That makes these animals more susceptible to heat stress.

Nighttime cooling. How much the air temperature drops at night is a factor. If the air temperature drops below 75°, cattle have a window for heat loss and often can recover. If the temperature stays in the upper 70s or higher, cattle start to accumulate heat, Spiers explains. "If a heat wave lasts three days or more, you've got big problems. That's when you start to see animals dying."

In 1999 in Nebraska, thousands of feedlot cattle died in a heat wave, due to lack of nighttime cooling combined with high humidity. They couldn't get rid of heat accumulation, he says.

"If you can create a break in the heat (finding ways to cool the animals) before you get to that third day, which seems to be the time it takes to develop a lethal heat load, you can prevent losses," Spiers says.

Acclimation. Cattle need time to adjust to heat.

"Here in Missouri we may have temperatures that suddenly go higher than 80°, and this can be a problem if cattle haven't shed winter hair yet," Spiers says. "By summer they have adapted. The same temperature is not nearly as much problem in August as a sudden hot spell in June."

Infected fescue. One factor that can greatly increase heat stress occurs when cattle graze pastures containing ergots or endophyte-infected grasses. These contain compounds that, by causing constriction of blood vessels in the skin, interfere with the animal's ability to dissipate body heat.

Thus the core temperature of the cattle increases, which leads to greater heat stress.

Animal adaptation

Spiers says there are four basic ways an animal can exchange heat with its environment to dissipate body heat:

- (1) evaporation;
- (2) radiant heat exchange (dissipation of body heat into the air);
- (3) convection (movement of air over the animal, taking some of the body heat with it); and
- (4) conduction (movement of heat from an animal to a solid structure, like the ground).

People don't usually think of cattle as being able to sweat to increase evaporative heat loss. They don't have as many sweat glands as a horse or a human, but Spiers says they do sweat fairly well.

Cattle also increase their respiratory rate, and when very hot will breathe through their mouths to increase evaporative heat loss, getting rid of body heat via the respiratory tract. This air exchange works to cool them, even when the air temperature is higher than the cow's core body temperature.

The other three methods of cooling — radiation, convection and conduction — are only effective when the air or solid structure (in the case of conduction) is cooler than the animal.

As an animal becomes hotter, blood vessels in the skin dilate to exchange heat with the environment, says Tom Welsh, professor of animal science, Texas A&M University. "They also drink more water to replace that lost through evaporation.

"If there's not enough water available, they conserve body fluid," he continues. "There are some hormonal changes that take place to conserve water in the body and aid sodium retention — with less sweating and urination.

"If they do have adequate water, then they can exchange heat through urination, salivation, etc. If they can replenish the water lost, everything they can get rid of takes heat with it," he says. They will also

slung their heads to put saliva over themselves, which increases the heat loss through evaporation from the skin.

You can help

Shade and water are the two most important factors for minimizing heat stress. Welsh emphasizes that

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clean, fresh water should always be available. “The recommendation is to provide at least 2 gallons (gal.) per 100 pounds (lb.) of body weight if the temperature is 70°. At 95° that intake may double, and lactating cows will need even more. If watering a lot of animals, you need an adequate water flow. If it’s an automated system, check it often to make sure it’s delivering the water.”

If you have a natural water source, make sure it is adequate. “One thing that happened here in Texas during our four-year drought was that ponds dried up,” Welsh explains. “The water became muddy with the animals tramping in it, and there was worry about pathogens in the stagnant water.”

Spiers says, “Shade is extremely important if you have an environment without much cloud cover. The animals that are constantly exposed to the sun get much hotter than those with access to shade.

“If using a roof for shade, it should be insulated, especially a metal roof,” he continues. “Otherwise you’ll get radiant heating (and it will be like an oven underneath). The usual recommendation is a roof at least 10 feet off the ground. The higher the better, to allow more air movement underneath.”

Avoid overcrowding of animals. In a pen or pasture, if you have limited shade, or only one water source and the animals are crowded around it, this reduces any beneficial effect of a breeze, Spiers says. “During hot periods, the dominant animals stay by the troughs to stay cooler, and the others can’t get to the water. The more watering areas you can provide, the better.

“It’s also wise to cut down on brush and windbreaks in summer pastures or pens; you want all the air movement you can get. Windbreaks and brush should be removed for at least 150 feet back from the sides of a pen to allow breezes to go through and cool the animals. They usually need about a 3 to 5 mph wind to effectively cool them, to remove the heat and water they are evaporating,” he explains.

“If cattle are in confinement, you can use fans. If they are outdoors, you can hope for clear nights with no clouds, to get some radiant heat loss. The sky is a heat sink, but if it’s cloudy, the heat sink is blocked and the cattle can’t get rid of the heat. You must resort to something else,” he says.

“You can spray them if they are in a small area and you have access to water, but don’t use cold water because it causes blood vessels in the skin to contract and shut down,” Spiers adds. The circulatory system needs to be able to keep bringing more blood to the surface of the body for cooling.

“If you are in a desert situation with dry heat, water evaporation is very effective, but if you have heat and humidity, it’s harder to lose heat through evaporation. As air temperature rises during the day, however, humidity goes down (unless you’ve just had a rain). As temperature drops at night, humidity goes up. You can often use evaporative cooling

(Continued on page 104)

Table 1: Observe behavior for these symptoms of heat stress

- More movement, as cattle try to find some comfort and look for a place to settle down;
- Nervousness and anxiety;
- High respiration rate (anything more than 100 breaths per minute);
- Drooling (getting rid of heat through saliva);
- Heavy breathing, sometimes with their mouths open;
- Raised heads (this means they are having trouble breathing);
- Standing in water or next to a water trough;
- Slinging saliva over themselves;
- Not eating.

Source: *Don Spiers, associate professor of animal sciences at the University of Missouri-Columbia.*

Beat the Heat *(from page 103)*

during the day, because humidity has dropped. If there's been rain and high heat, however, the air is already full of water, and that's often when we get into critical conditions with animals dying," Spiers says.

Welsh cautions stockmen to avoid working cattle in the middle of the day; it's better done in the early morning when it's cooler.

"Avoid bunching them up, and give them rest periods if it gets hot," he says. "There's no air movement when cattle are jammed together, nor in solid-panel corral chutes. Those can get very hot, as well as being physically and psychologically stressful, which raises animals' temperatures."

Working cattle that haven't been worked before will elevate their body temperature from 0.5° to 3.5°, just from stress and exertion, Welsh says. "Anything you can do to minimize stress will help. Move them in smaller groups. Give them less standing time when they're all confined in an alleyway or in the chute."

**Ongoing Research**

If she's outdoors, much of the heat buildup in the cow's body is from the sun, says Don Spiers, associate professor of animal sciences at the University of Missouri-Columbia. He is carrying on the work of H.D. Johnson (now retired), who was one of the first researchers to use environmentally controlled chambers to monitor intake of water and feed at various temperature and humidity levels. Past research conducted in environmental chambers didn't take the sun into consideration.

"Over the last couple years we've started to use temperature transmitters that the animals swallow to send us their temperature every 5 to 10 minutes," he says. "The transmitters are supposed to last 10 to 15 years. We can pick up the transmission a mile away."

A company is developing the temperature transmitters for both beef and dairy cattle, hoping to make them inexpensive enough for producers to afford. They could then choose one animal in the herd to act as a sentinel.

The transmitter is swallowed and lodges in the gut, where it continually sends out the temperature. "Instead of having to calculate air temperature, humidity, wind speed and all these factors, you merely need to know how hot the cattle are getting," Spiers says, adding that they are hoping to simplify things for producers.

Another research project is monitoring cattle on pasture and in feedlots to evaluate the animals' temperatures along with the radiant heat of their environment — how hot an object becomes when exposed to sunshine.

"We've found that radiant heat can increase body temperature greatly," Spiers says. In the summer of 1999, Spiers witnessed air temperatures up to 100° F and radiant temperatures as high as 120°.

"We consider this to be representative of what the animal was receiving. On an animal with dark skin, the temperature of the skin could get as high as any other dark object. This is a significant factor," he says. "If you touch an object that's been sitting in the sun, it's much hotter than the air temperature."

The temperature/humidity index alone is not always an adequate indication for heat stress danger. "It doesn't factor in radiant heat," Spiers warns. "When the index was designed, it was based just on air temperature and humidity, so now we are trying to come up with another index that incorporates radiant heat load as well."



Heat stress reduces reproductive rates

by **HEATHER SMITH THOMAS**

Heat stress can have a dramatic impact on the reproductive rate of a cow herd by affecting bull fertility and embryonic loss.

Dennis Maxwell, of Iowa State University's (ISU) McNay Research Farm, recalls a University of Missouri project in which the calving season was moved to early summer to coincide with grass availability. "That put the breeding season in late summer when temperatures were high. The cows had a very poor conception rate (30%)."

Maxwell says in their southern Iowa herd they experienced embryonic losses due to heat stress during an extremely hot period in mid-July a couple years ago. Producers trying to avoid muddy conditions at calving time found that shifting their calving season back a month or two timed breeding season with hot weather.

Curtis Youngs, ISU reproductive specialist, says his primary concern about heat stress involves the time of breeding. "If a cow has been bred and she's under heat stress, even if fertilization does occur, the embryo is very likely to die."

The most common time for heat stress to cause embryonic loss is in the first week after mating, although a pregnancy can be lost anytime during the first month.

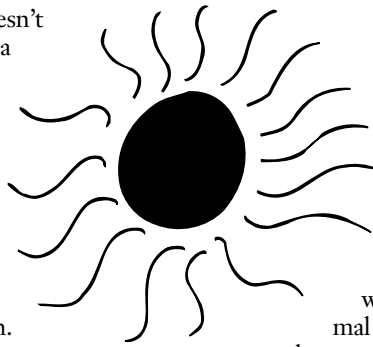
"Mother Nature doesn't want to add more stress to a cow that's already stressed, so if a heat-stressed cow has just been bred, the pregnancy is often sacrificed," Youngs explains.

"The other time we see adverse effects on pregnancy from heat stress is in late gestation. Anything that stresses the cow or fetus at that time can trigger a premature birth, which usually leads to death of the calf," Youngs says. He advises timing calving and breeding to avoid the worst heat of summer.

Maxwell reminds breeders that extremely hot weather can cause problems with newborn fall calves, as well. "If you have a black calf out in the middle of a pasture with no breeze and it's 100° F, that can be a problem," he says. Young calves may not feel like nursing in hot weather, which can lead to dehydration.

Watch bulls

Reproductive problems can also occur if bulls are subjected to heat stress, which can lead to infertility. Sperm being formed must have an environment about



7° cooler than normal body temperature. Ordinarily the testicles hang down away from the bull's body, providing a cooler environment.

Heat stress can cause mild subclinical fertility problems in which the bull has a normal sex drive and mates with the cows, but fewer cows than normal conceive. Or it can cause a severe fertility problem by completely wiping out the whole population of spermatozoa that are in the testes and are being stored in the epididymis.

"This causes a true sterility for 45 to 60 days, the length of time depending on how severe and how prolonged the heat stress was," Youngs says.

"Severe heat stress will affect mature sperm that are being stored, so there will be some immediate effects. But the long-term problems we run into are from damage to the sperm that are in the process of being formed," he explains. "These immature sperm cells will take the same length of time to get through the system [as normal sperm would], but once they get there, they are no good.

The bull could be infertile for up to two months after severe and prolonged heat stress."

Sometimes the first few matings are fine, and then no cows become pregnant. Once the heat-damaged sperm work their way through the system and are gone, the bull has normal sperm again and fertility picks up.

If a stockman encounters severely hot weather during breeding season, one suggestion Youngs offers is to do only night breeding. "Turn the bull out with the cows in late evening, leave him with the cows all night, then entice him back in with a bucket of grain in the morning to lock him away from the cows during the heat of the day," Youngs says.

"It also helps to have bulls in good body condition before breeding season begins. If a bull is thin, and then experiences a heat wave, he won't have much appetite and will lose even more weight. This can interfere with his energy and breeding ability. Well-managed animals can do a better job of tolerating short-term stresses," Youngs explains.

