Beat the Heat

Preparation is the key to keeping your cool when heat stress becomes a problem.

by Brad Parker

They're called dog days, but summer conditions probably make life tougher for your cattle than for your canine.

When climatic conditions cause discomfort, they become a stress that can reduce animal performance and undermine profitability. And deciding when things are becoming stressful for cattle requires more than simply stepping outdoors.

"It's not a good thing to base the amount of strain on an animal on how humans feel," explains Donald Spiers, associate professor of animal sciences at the University of Missouri-Columbia (MU). "Humans are much better at getting rid of heat."

To gauge the stress level cattle may be experiencing, scientists have developed a discomfort index, or the temperature-humidity index (THI). As the name implies, it is based upon the combination of ambient air temperature and relative humidity.

An emergency is likely when the THI reaches 84, which occurs, for example, at 105° F when the relative humidity is 20% or at 84° F when the humidity is 100% (just after a rain).

Often, when temperatures are higher, relative humidity is lower because warmer air can hold more water. Therefore, animals usually are able to rid themselves of more body heat via evaporation when it's hot. But when the relative humidity is high, the air is more saturated, so the cooling effects of perspiration are diminished, and the cattle experience stress at lower temperatures.

Day and night

Ambient air temperature is partly the result of infrared radiant heat. This energy is below the visible-light spectrum and is commonly referred to as the temperature "in the shade." The heat associated with visible light, however, plays an equal part in the perceived temperature. This solar-radiation load is greater on cloudless days.

Solar radiation can elevate the surface temperature of dark-hided animals 10°-20° F.

Slopes facing south or west increase exposure to solar radiation. This is particularly an issue in feedyards, many of which in the Upper Midwest were built on these slopes to make the most of sunny days in the winter.

Groundcover makes a difference, too. Bare earth and shorter grasses allow more solar infrared radiation to be reflected toward the animal. Tall grasses are cooler in that regard, but they reduce air movement, which is another environmental piece of the heat-stress puzzle. Even a light breeze increases an animal's ability to dissipate body heat via convection.

The daytime conditions aren't the only ones that require observation.

"If the nighttime temperature does not drop below 76° F, [cattle] don't have a very good opportunity to lose a lot of the heat that they've accumulated during the day," Spiers says. "The cooler the nighttime air, the more heat they can get rid of."

The importance of the environmental conditions themselves is matched by the importance of the rate at which they change. Animals need time to acclimate, so it's best if warming trends take two or three weeks. "If it happens over two or three days, you have a problem," says Terry Mader, beef cattle specialist at the University of Nebraska's Haskell Ag Laboratory in Concord.

To add to the stress, summers generally include a series of alternating warm-ups and cool-downs with the peak heat stress occurring in mid-July.

Cattle's tendency to acclimate explains

Research at the University of Missouri-Columbia found cattle in the shade take half as many breaths per minute and have body temperatures about 4° F lower than those in full shade.

why heat strain often is more severe in late spring and early summer, although conditions may be the same in early fall.

More to it

Younger, smaller animals tend to lose heat more rapidly due to the greater ratio between their surface area and mass, Spiers says. Heat-related deaths occur among a higher percentage of cattle that weigh more than 1,000 pounds (lb.). Both subcutaneous (sub-Q) fat and muscle serve as insulation that keeps body heat from dissipating.

While older animals are often heavier, age has its advantages, Mader says. He believes older animals are more adaptable.

An animal's diet affects the amount of heat stress it experiences. Rations that require more metabolizing increase the body's core temperature, which results in more heat that needs to be dissipated.

While compensatory gain is economically beneficial, animals trying to make up for lost time following an initial heat wave generate more body heat, making them more susceptible to future heat episodes. The subsequent heat wave may not be as severe, Spiers explains, but the strain could be worse than the first time.

A shorter, thinner hair coat is more desirable in warmer conditions. Color is a factor, too. Dark hides will absorb more of the visible light and its associated heat energy.

Mader says solar radiation will elevate the surface temperature of a light-hided animal 5°-10° F. Dark-hided animals will experience elevations of 10°-20° F.

Of course, combinations of stress factors make matters worse. Mader says fat, dark-hided cattle account for 75% of death losses due to heat.

Consequences

Death is an uncommon response to heat stress, however.

"We will occasionally see an isolated case where an animal does succumb to the heat," Mader says. "There's also a possibility there was some other ailment." In other words, cattle that die during episodes of extreme heat probably suffered from something else, and the added stress just finished the job.

More often, the results of heat stress are lowered conception rates or embryonic death in cow-calf operations. Roger Pierce of Pierce Angus Farm, Hancock, Iowa, says cattlemen in his area saw 10%-20% of their summer-bred females come up open last fall. Part of the problem, he says, is decreased bull fertility.

"If a bull gets down because of the heat, it can take him 30 days to rebuild," Pierce explains.

Other economic effects include reduced growth rates and depressed immune function. "We don't have a good understanding about what level of temperature or humidity is needed to cause a change in the health of the animal," Spiers admits, but he says research into that question has begun.

Although there's no equation that takes environmental factors into account to predict economic consequences, Mader estimates that last summer's heat wave in Nebraska cost producers $21 million. The 5,000-8,000 head of cattle that died were worth $5 million, he figures, and lost performance stole another $16 million.

The economic effects of heat stress can come back to haunt cattlemen well after the last 80° day. As with any stress, cattle that must battle the heat may hang dark-cutting carcasses. That means a discount at the packing plant.

Telltale signs

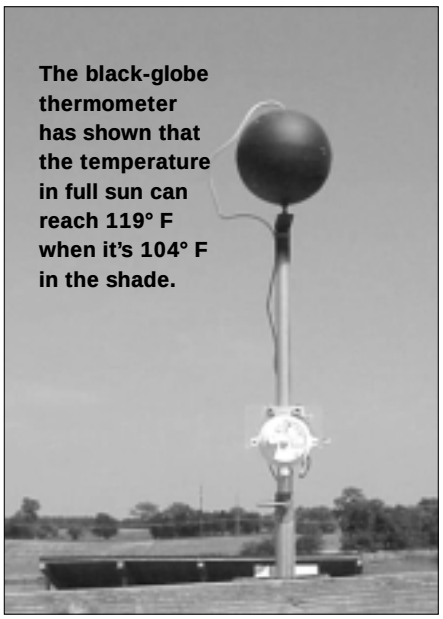
Darrell Busby, Iowa State University Extension livestock field specialist, cautions producers not to rely on weather forecasts to predict when conditions may become stressful for cattle. "Observing the animals and their behavior is the best indicator of problems," he says.

The biggest red flag probably is reduced feed intake. "That's where it really hits you in the pocketbook," Busby says. "That's where heat stress is somewhat of a bigger problem than cold stress; they back off from eating."

Busby's list of abnormal behavior also includes heads submerged in stock tanks, agitation, restlessness, refusal to lay down, open mouths, labored breathing and excessive salivation.

Spiers says cattle rarely lay down when heat-stressed so as to expose more of their bodies to air-cooling. Crowding may be a mechanism by which they try to shade each other, he theorizes, but too much will reduce airflow around the animals and defeat the purpose. Those that seek shade probably are strained.

As temperatures climb above 75° F, adult beef cattle will begin to pant. This increased respiration increases metabolism, which increases the animal's maintenance requirements 11%-25%, Spiers says.



The black-globe thermometer has shown that the temperature in full sun can reach 119° F when it's 104° F in the shade.

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Made in the shade

There are steps producers can take to reduce heat strain for their cattle. Dark-hided animals probably benefit most from shade because a significant portion of ambient temperature and the accompanying heat load result from solar radiation.

A survey of Iowa feeders following the 1995 heat wave in that state found that 46 lots without shade posted an average death loss of 4.8%, and the lots with shade averaged 0.19%. The 41 lots that experienced no deaths averaged 19.4 square feet (sq. ft.) of shade, and those with more than 2.5% death loss averaged 0.89 sq. ft.

"If you had shade, this event wasn't a problem," Busby concludes.

In research conducted at MU last summer, two groups of Angus-based cattle were rotated between shaded conditions and full sun. Each animal carried a body-temperature-sensing implant.

For four days in mid-July, the air temperature hovered around 100° F, and the skies remained clear. In the shade, the cattle took an average of 90 breaths/minute and had an average body temperature of 102° F, which isn't much greater than normal. In full sun, they took twice as many breaths, and their temperatures climbed to an extreme level of 106° F.

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Thanks to a new use of an old device, the black-globe thermometer, the scientists also were able to record continuously the radiant energy being received from full sun. While it was 104° F in the shade, the black globe recorded 119° F.

If natural shade isn't available, artificial sun blocks can be built. Spiers says such structures are more effective with reflective roofs having a layer of insulation beneath them. The key is to keep as much heat as possible from being conducted to the space under the shelter.

Mader cautions producers to examine the costs and benefits of artificial shade before building.

"If you look at the cost of putting up shade and the cost of maintenance, it's hard to justify building shade for basically 45 days of the year," he says. "Yes, it will minimize death loss during those times you have heat waves, but there's probably only going to be two times in a decade when you're going to experience death loss."

Mader says that sources of shade, either manmade or natural, must provide 15-25 sq. ft. for each animal and be a minimum of 10 ft. off the ground to allow for adequate air movement. Otherwise, the benefits gained from reducing surface temperatures will be lost.

Spiers agrees with the 10-ft. minimum and places the upper limit at 14 ft., but he says he would rather see 20-40 sq. ft./animal for coverage. He also suggests keeping any obstacles, such as brush piles and buildings, 50 ft. from the shaded area to improve airflow.

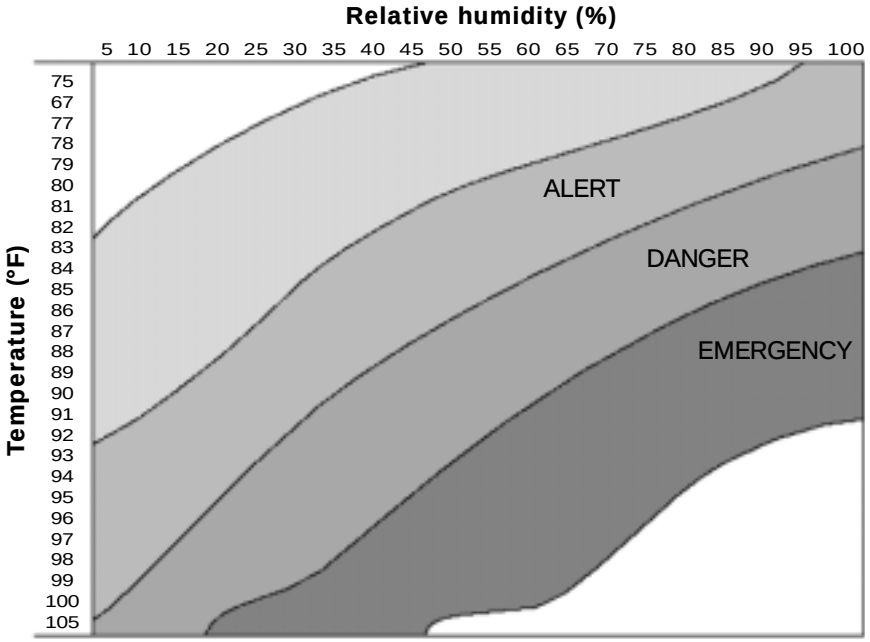
Having a sufficient number of trees to shade the whole herd is good, Spiers reminds producers, but too many trees too close together will reduce ventilation.

Busby agrees, adding that he would rather see no trees at all than too few. "The worst thing in the world is to have one tree and all of the cattle trying to huddle around it," he says.

STEVE SUTHER PHOTO

When air temperature matches skin temperature, producers should consider wetting their cattle.

Livestock weather hazard guide



SOURCE: UNIVERSITY OF NEBRASKA-LINCOLN

Wind, water

Sometimes shade isn't enough, so producers increase airflow with fans. Spiers says studies in dairy operations have shown that it may be most beneficial to use fans at night. This increases the gradient for heat loss.

"If you can drop their body temperatures below a certain point at night," he explains, "they can be exposed to that heat during the day, but their body temperatures won't get up to that critical level."

This doesn't mean fans don't serve a purpose during the day, Spiers emphasizes. It's important to use them then, especially in confinement situations. What's more, avoid higher animal-population densities when it's hot to increase air movement and to reduce other stressors.

In feedyards, mounds increase airflow and prevent bunching. Hilltops serve a similar function in pastures, where animals also can migrate to eastern and northern slopes. Again, it's important that population densities aren't so high as to cause overcrowding on prime real estate.

Certainly, a favorite spot for cattle in hot weather is the local watering hole. While many water sources are placed out of the wind in the winter to avoid freezing, that's exactly where they should be in the summer. Mader recommends 1 linear inch (in.) of water space for each animal, and 3 linear in. has been found to eliminate nearly all panting.

"If we can make sure that cattle can get to water and have access to it in liberal quantities, we can almost eliminate the effects of the heat," he says.

Busby points out that a 1,000-lb. animal will drink 14.5 gal./day when it's 80° F and 20.6 gal. when it's 90° F. Flow capacity, therefore, is important.

Shower power

While water certainly does its part inside the animal, outside water helps, too.

Spiers says that once the air temperature matches the skin temperature (which is lower than the rectal temperature), the situation is critical. "Once that happens, there's no temperature gradient for heat loss," he explains. "That animal is going to overheat."

The only means for cooling under those conditions is by evaporation. "You could even put fans on the animal; but you're blowing hot air, and the animal's not going to lose heat," Spiers says.

Busby says this strategy disproves the old theory that spraying cattle with water in hot

weather would kill the animals, and 89% of respondents to the 1995 survey indicated spraying water was their most effective countermeasure.

Busby encourages producers to ready the necessary equipment June 1 in case they need it. A few test runs when the weather isn't severe are beneficial, Mader says, not only to ensure the equipment works, but to familiarize the cattle with it.

There are certain strategies to cooling cattle with water. Mader says it's best to begin early on days with the potential for heat stress. "You're ahead if you can prevent the cattle from getting heated in the first place," he says. "Start in the morning rather than in the middle of the afternoon."

Whenever the process begins, Busby and Spiers recommend spraying for about five minutes of every half-hour, letting the animals dry between bouts. This recommendation is mainly a cost-saving measure, Busby says, because cattle tend to move in and out of the water anyway, as if they understand the evaporation is key.

Spiers adds, "Once that water is dripping off the animal, it's not doing them any good."

In fact, that could be creating another problem. On bare earth, resulting mud can add to the stress by inhibiting movement. It also can become caked on the animals' hides, adding another layer of insulation that reduces cooling ability.

While Mader agrees with avoiding mud, he adds that cooling the ground, which may reach surface temperatures of 150° F, may be equally beneficial.

All three advisors warn against inadvertently increasing humidity while spraying. Large water droplets are recommended instead of fine mists, which more easily evaporate before making contact with the animal.

Mader offers another suggestion based on cattle's natural tendencies to stand in water when it's hot. He says there's greater benefit in spraying their legs because there's less sub-Q fat there, and the evaporation has a greater effect.

While he admits this can be difficult to accomplish, Mader concludes, "The work we've done would suggest that sprinkling their legs and wetting the surface of the feedlot is preferential to wetting the cattle's backs."

Feeding strategies

Another natural tendency for cattle experiencing heat stress is to eat less, which decreases the amount of internal heat generated by metabolism. While it may interfere with a producer's goals, limiting feed could mean the difference between life and death.

Mader says that during adverse climatic conditions and for a few days following, it is often better for producers to manage feed intake rather than letting the animals do it. Cattle often will wait until the second or third day of a heat wave before they back off feed. If the heat wave is too severe, that will be too late to make effective changes.

Spiers says, when prolonged high temperatures are suspected, cattlemen should start restricting feed early. He also recommends feeding a ration that produces less heat. More digestible fiber may be an answer, but acidosis is a concern. Less protein will mean less nitrogen, a byproduct that requires a lot of energy to eliminate.

Pierce has found reducing the amount of concentrate in the ration helps cattle deal with the heat.

Another way to reduce metabolism is to feed more, smaller meals. This method often is used with strategic feeding times, which are based on the fact that cattle's body temperatures peak about four hours after eating.

Busby suggests feeding 60% of the ration in the evening so body temperatures peak around 4 a.m. The remainder should be fed early in the morning so the smaller spike in body temperature occurs before noon.

This system also has applications in rotational grazing. By moving cattle to a new paddock near the end of the day, they'll eat and metabolize the fresh grass at night.

Cattle naturally will adjust their own feeding schedules to reduce their heat loads, Pierce says. He has observed cattle on pasture will graze early in the morning, seek shade from noon to 5 p.m., then graze more.

Whatever changes are made should be incorporated slowly, Busby advises. Therefore, producers need to begin switching to their hot-weather feeding strategies in June.

Less stress is best

Producers should minimize other stressors during hot weather.

Work cattle early in the morning, and transport them at night. This not only reduces stress on the cattle, but it reduces the likeliness of cowboys' suffering heat exhaustion.

"If you're going to work cattle on days when you think it's going to be hot, it certainly needs to be done by 10 in the morning, but preferably done by 8 o'clock so they have time to cool down before the heat comes on," Mader says.

Pierce says he tries to control flies to eliminate unnecessary movement or huddling during the heat. He also tries to plan his breeding season to avoid the warmest months of the year. If an animal must be bred when it's hot, he'll wait until evening. "I'll AI (artificially inseminate) them at midnight if I have to," he says.

Busby notes suppressing estrus may be beneficial. He says that heifer lots being fed MGA® in 1995 exhibited about half the death loss of those that weren't. One feedyard manager indicated the first heifers to die were the ones that had cycled just before the heat wave.

All emergency plans hinge on reducing the stress to susceptible animals. Of course, implementing those plans could cause stress, so Busby advises planning ahead and taking precautionary measures to minimize stress.

"Most cattle can deal with one stressor pretty easily," Mader says. "But if you have mud, if you have flies, or if you work the cattle, then those are multiple stressors that, in combination with high heat load, can contribute to death losses and reduced intakes."

Excessive salivation, panting and restlessness are a few of the signs of heat stress.