Cool Those Cattle

Helping your cattle stay cool during the warmest months of the year sometimes takes extra effort, but recent statistics confirm that it is time and money well-spent.

by ***Ed Haag***

Heat stress doesn't just mean lower productivity in beef cows. If not dealt with appropriately, it can be fatal. In 2007 a heat event in northwest South Dakota killed up to 7,000 animals. During the last decade, events of similar magnitude have been recorded in northeast and southeast Nebraska.

These events and the resulting deaths have not gone unnoticed by the staff at the Roman L. Hruska U.S. Meat Animal Research Center (USMARC) at Clay Center, Neb. The U.S. Department of Agriculture-Agricultural Research Service (USDA-ARS) scientists there were convinced that providing beef producers an accurate forecasting tool specifically designed to predict such heat events would help them explore all their options and launch a timely response.

"What we were thinking was that if producers knew when it was going to be hot, then they could plan for the movement of their animals, the working of animals, as well as planning to have extra people on hand to watch animals if problems developed," says Tami Brown-Brandl, research scientist at the center.

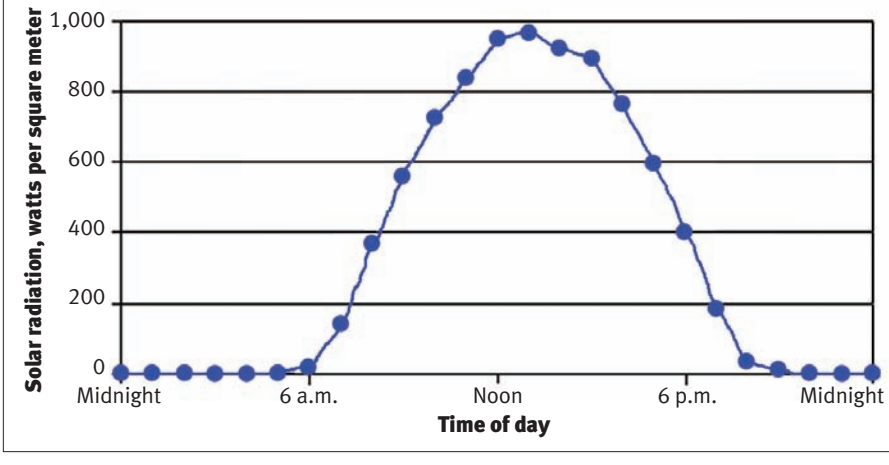
Working with resources from as far away as Australia, she and fellow USMARC agricultural engineer Roger Eigenberg developed a comprehensive model that uses local and regional weather data to predict potentially dangerous heat events. The model has since been successfully incorporated into a public access Internet web site that displays a seven-day forecast as a series of color-coded maps (see Fig. 2). These are updated twice daily.

The site, *www.ars.usda.gov/Main/docs.htm?docid=16750* (click "Heat Stress" link in left navigation bar), was launched in spring 2007 and initially covered southern South Dakota, Nebraska, Iowa, Kansas, Missouri, Oklahoma, eastern Colorado and northern Texas. After a high mortality heat event struck north-central South Dakota in summer 2007, the remaining counties of that state were added to the area being monitored.

Table 1: Stress categories as defined by predicted breathing rate

Predicted breathing rate	Heat stress category
<90 breaths per minute	Normal
90-110 breaths per minute	Alert
110-130 breaths per minute	Danger
>130 breaths per minute	Emergency

Fig. 1: Solar radiation by time of day



Special threat, response

The ARS isn't the first federal agency to offer livestock weather warnings. Through the mid-1990s the National Weather Service (NWS) produced weather bulletins that were relayed to farmers and ranchers via local radio stations. After budget cuts ended national alerts, responsibility for providing weather information to beef producers fell to a patchwork of university web sites. Brown-Brandl notes that while these sites provided a valuable service to their respective agricultural communities, they weren't always equipped to predict specific high-mortality heat events.

She adds that because these events tend to be sporadic and localized — often involving less than a county — it wasn't uncommon for conventional weather forecasters to overlook their development.

"The reason for going online with our web site was to predict these very localized heat events that have killed thousands of cattle," Brown-Brandl says.

To accomplish this task, raw data pertaining to temperature, humidity, wind speed and cloud cover (solar radiation) is forwarded to USMARC from the National Oceanic and Atmospheric Administration (NOAA)-NWS. This material is then used in USMARC's computer model to estimate cattle heat stress response.

Any plan better than no plan

For Roger Eigenberg, co-developer of USMARC's heat stress model and web site, having a plan in place to deal with heat events is a major step in averting disaster.

"If a producer knows that one of these heat waves is likely to occur and can make the appropriate adjustments to his cattle management program — even if the adjustments are just minor — they can have a significant impact on the outcome," he says, adding that any plan is better than no plan.

Contingency planning for cow-calf operators might involve identifying locations with adequate water and shade that animals can be moved into before a heat event.

"The importance of having enough cool, clean water cannot be overstated," Eigenberg says. "It is the key." He adds that it is essential in helping keep an animal's internal body temperature within normal limits. It prevents dehydration and allows heat to be dissipated through evaporative cooling (sweating) and urination.

As temperatures rise, so does the demand for water, Eigenberg says. On days that it exceeds 80° F, cattle need more than 2 gallons (gal.) of water per 100 pounds (lb.) of body weight per day. This means, under heat stress conditions, a properly performing water system needs to deliver a minimum of 1.1% of body weight per hour.

He adds that this should be a consideration when making contingency plans.

"It is very important to have adequate water well in advance of a heat event," he says. "It takes awhile for animals to acclimate to a new water source, and waiting until a heat event to add a new stock tank may not be as helpful as it might seem."

A similar risk applies to waiting until an actual event before introducing cattle to sprinklers, Eigenberg adds. "Animals that are not used to sprinklers have a tendency to run from them," he says. "Not only do they not benefit from the water, but they become agitated and more susceptible to the heat."

For Eigenberg, wetting animals with sprinklers to reduce the effects of heat stress is most effective when there is wind to promote evaporation and the humidity is low. He points out that in high-humidity situations excessive moisture in the corrals can often worsen the situation. This is best controlled by allowing the animals and the ground to dry thoroughly between water applications.

Finally, when installing new water lines or refurbishing old ones, avoid placing them where they are exposed to the sun, Eigenberg warns. "As the temperature of the water increases, animals have a tendency to drink less," he says, pointing out that burying supply lines so they remain cool will go a long way to making sure that the cattle are consuming the water they need to remain healthy.

Shade: a balancing act

Eigenberg notes that unlike the clear-cut role an adequate supply of water plays in reducing heat stress, the role of shade is more nuanced.

Research supports the view that in a pasture environment it makes sense to take advantage of the natural shade provided by trees. The fact that they provide the lowest-cost shade solution offers a compelling argument for preserving existing shade trees as well as planting new ones for use in the future.

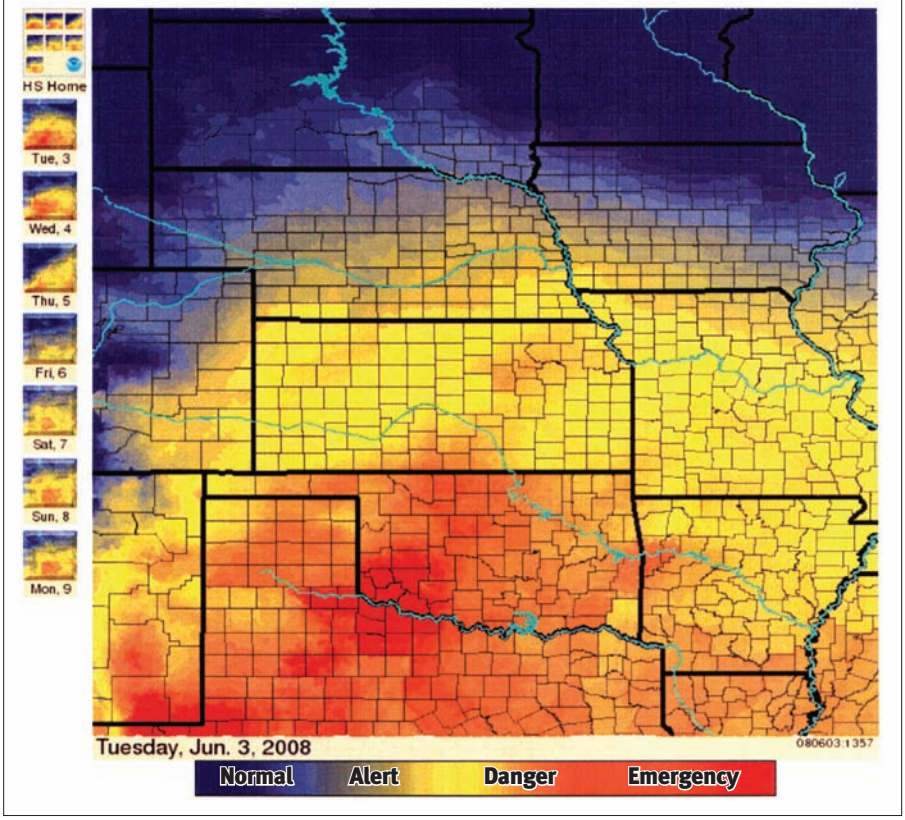
A feedlot environment is different, Eigenberg says. The cost associated with building shade structures is often balanced against their economic benefits, and with heat events occurring only sporadically, it can prove difficult to justify the initial expense. He cautions that research has shown there is only limited economic benefit to shade structures apart from a very significant heat event.

"It is like buying insurance," Eigenberg says. "It doesn't do much good until you need it, and then you are really glad you got it."

In an effort to address the cost vs. benefit issue, Eigenberg and Brown-Brandl have been evaluating low-cost structures that offer limited cover.

"The Australians have tested a slatted material that provides between 50% and 60% cover with a fair amount of success," Eigenberg says. "What we are finding in our preliminary research is that if there is something you can put in place prior to the hottest months of the year it will have a significant impact on the survivability of the animals."

Fig. 2: Heat stress forecast originated Tuesday, June 3, 2008



Identify vulnerable animals

Finally, on the issue of shade, Eigenberg warns that if limited shade is available during a heat event, the interest of one group in particular should take precedence.

"Shade is a valuable consideration for animals that might be vulnerable," he says, adding that these high-risk cattle include finished cattle that are ready for market, cattle in poor condition and cattle that have recently arrived.

Others to consider are those that have pneumonia or have been treated for it, non-heat-tolerant breeds, and individual animals that have been moved from a cooler part of the country and haven't had time to acclimatize. He points out that it makes sense to identify these animals before an event and make provisions for their well-being. Besides providing them with on-site shade, other strategies are available to operators who are aware of a pending heat event.

"With feedlots and finishers it might mean shipping more vulnerable animals early to avoid potential fatalities," Eigenberg says, adding that this one move, which

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involves little more than rescheduling, could reduce a feedlot's risk dramatically.

Handle with care

For even the healthiest of animals, Eigenberg recommends a modified schedule during a heat event that minimizes any activity that requires working with cattle. Researchers from the University of Nebraska have determined that movement or handling of cattle during hot weather can change (increase) an animal's body temperature from 0.5° to 3.5°. If it is absolutely necessary, they recommend it be done in the morning, prior to 8 a.m. if possible and never after 10 a.m. unless shaded facilities are available. Also recommended is a 30-minute time limit on any handling or processing activity to reduce the chances of overheating and to allow the body core temperature to return to normal as soon as possible.

Another rescheduling consideration during a heat event is when animals are fed. "Intuitively it makes sense to feed earlier in the day, when it is cooler," Eigenberg says. "This is preferable to later in the day, when the ambient temperature is up and all the heat components are in place." AJ

Know the signs

For the heat stress scientists at Roman L. Hruska U.S. Meat Animal Research Center (USMARC), one of the critical components in responding to a heat event is being able to identify the symptoms of heat stress. Roger Eigenberg, USMARC agricultural engineer, notes that their heat stress computer model is based on respiration rate and, as such, it is a good indicator for cattle.

"Respiration is a primary mechanism for heat loss," he says. "As an animal breathes, it evaporates moisture and cools the body."

Eigenberg goes on to explain that as the stress increases, so does the number of breaths per minute. "That is one of the responses a producer can look at," he says, adding the caveat that there is some significant variation in respiration rates between individual animals. "But on average it works well."

Other symptoms of heat stress follow a six-stage linear progression from early indications to critical symptoms.

"In the first stage you will start to see an elevated breathing rate, some display of restlessness and more time spent standing," Eigenberg says.

As the heat stress progresses to Stage 2, Eigenberg notes that in addition to an increase in the symptoms that were first manifested in Stage 1, drooling and grouping begins to occur.

In Stage 3, breathing is rapid, behavior is more restless, foaming begins and grouping behavior is more pronounced.

"At first you would think that clustering together would just increase the heat stress because the wind is being blocked, but what they are actually doing is creating shade for one another," Eigenberg says. "By standing close to one another they are blocking the solar component."

In Stage 4 the breathing rate is accelerated to the point where open-mouth panting begins. This behavior becomes more exaggerated in Stage 5, with the animal pushing from the flanks, its tongue is beginning to protrude and there is excessive drooling and foaming at the mouth.

"Finally, in Stage 6 the tongue is definitely protruding, the breathing is labored, the head will be down and the respiration rate and drooling might even decrease because the animal is just not capable of keeping up with the heat load," Eigenberg says.