Feedlot Heat Stress Checklist

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Cattle Do Not Handle Heat Stress as Well as Humans

The thermo-comfort zone varies greatly for beef cattle. Young animals have a narrow comfort zone between 45 and 80°F (7.2 and 26.6°C). The comfort zone of feedlot cattle and mature cows will range from subzero temperatures in the winter to around 75°F (23.8°C) in the summer, depending on body condition, hair coat length and plane of nutrition. This wide comfort zone allows cattle to thrive under diverse climatic conditions with little or no need for shelter or protection. However, unlike humans, who can be reasonably comfortable when exposed to normal summer temperatures, feedlot cattle have difficulty coping with temperatures above 90°F (31.9°C). This is particularly true when humidity is high or wind speed is low, especially when cattle have had little or no chance to adapt to excessive heat loads.

Evaluate the Potential for a Heat Stress Emergency to Develop

Managing heat stress in cattle starts by evaluating the potential for a heat stress emergency to develop in your area. To the extent possible, anticipate the crisis so you can get maximum benefit from your plan. Evaluate the previous history of heat stress events or the potential for a heat stress event to occur at your location.

Key elements to be included in your evaluation are:

1. The normal annual rainfall in your area. High rainfall areas are more susceptible to having high humidity.
2. Precipitation above normal, particularly if wet weather continues into the summer months.
3. Long-term weather forecast of hotter than normal conditions, which should signal early activation of a heat stress management plan.
4. Obstruction to airflow in cattle pens. Windbreaks and other airflow obstructions will create calm airflow up to 10 feet (3.05 m) downwind for every one foot (0.30 m) in height. A windbreak 10 feet high will obstruct airflow 100 feet (30.48 m) downwind. Wind is your friend: 1 MPH wind will decrease the Temperature Humidity Index (THI) about 1 unit.
5. Availability of water for watering cattle. Animals on average can easily consume one to two gallons (3.78 to 7.57 L) of water per hour, under normal environmental conditions. Watering space and water flow to watering troughs should also be evaluated to ensure cattle are protected from dehydration.
6. Special protection, water supply and airflow may be needed to help black hided cattle and cattle on all-natural feeding (no implants or feed medications) programs to keep cool.

Developing a Heat Stress Management Plan

Below are listed some ideas for your plan. The first items listed are more easily accomplished and may significantly improve the performance of cattle during times of heat stress. They should always be done when the possibility exists of heat stress reaching the upper critical limits of cattle.

Have Ample Water Available

At temperatures above 80°F (26.7°C), cattle may need in excess of two gallons (7.57 liters) of water per hour per 100 lb (45.4 kg) of body weight. Consuming water is the quickest and most efficient method to reduce body temperature. Water prevents dehydration and allows heat to be dissipated through evaporative cooling (sweating) and urination. Put out extra watering tanks if needed; this should be done in advance of anticipated need so animals become used to multiple water sources. Providing 5½ inches (13.97 cm) of linear space per animal can be lifesaving in feedyards and ensure that all cattle can get water when needed. Having ample linear space for cattle to drink and stay cool also can be important in maintaining cattle performance during the summer. Add additional water tank space, so that cattle have access to at least five gallons (18.93 liters) per hour. Keeping waterers clean should encourage water consumption. Weekly scheduled waterer cleaning also improves the likelihood of finding any malfunctioning waterer.

Avoid Handling Cattle if Possible

Processing cattle can elevate body temperature 0.5 to 3.5°F (-17.5 to -15.8°C), depending on cattle temperature and processing time. During heat stress periods, if cattle must be handled, work them in the early morning (prior to 8 am and absolutely not after 10 am) and in a shaded facility if possible. While it may seem to make sense to work cattle after sundown, wait until the cattle have had at least six hours of night cooling

before working. Dissipation of body heat is needed at night and allows cattle to deal more effectively with heat stress during the day. Work with the packers to schedule shipping cattle at night or at least early morning. Try to start loading early enough so that all cattle can arrive before 7 am. Most packers have sprinklers and can keep the cattle comfortable. If cattle arrive with body temperature elevated above what would normally be expected, carcass defects such as dark cutters may be more common.

Cattle that must be handled during hot days should spend no more than 30 minutes in the handling facility (processing or hospital area), i.e. only put 30 minutes worth of cattle in the tub or snake. Avoiding cattle bunching is equally important. Most cattle-working facilities have very poor wind movement, causing cattle to gain body heat while they are in these areas. A 30-minute time limit minimizes the heat gain and allows the body core temperature to return to normal quicker, so the feedlot animal can deal successfully with heat stress. Arrange to have shade and sprinklers in those areas. Tubing (0.5 to 0.75 inch; 1.27 to 1.91 cm) equipped with spray nozzles (one nozzle per five animals) placed overhead will improve the cooling in handling and holding areas.

Change Your Feeding Patterns and Consider Backing off the Energy

Shifting the feeding schedule toward evening deliveries may help hold cattle on feed and even out the consumption patterns. Delivering 70% or more of the daily scheduled feed two to four hours after the peak ambient temperature of the day has been reached may decrease the roller coaster intake patterns often observed. Moving to a late-day feeding schedule may also minimize the subclinical acidosis that is thought to contribute to the problems seen in times of heat stress. Lowering the energy level has been controversial, but research indicates that lowering the energy content of the diet or using a storm ration may lower the heat load on the cattle.

The following items may be more difficult to accomplish, requiring more intense prior planning, labor, and materials to implement. The key is to know where your potential problem areas are and focus your efforts on critical areas first.

Assess water supply and delivery capacity ... availability to an animal equals linear space and water volume over time at the space occupied by the animal. The objective is to allow all cattle to get half their daily need within an hour. Shoulder-to-shoulder feeder cattle can require up to 32 inches (81.28 cm) of linear space. If cattle can get their required water in 10 minutes, it would mean each mature feeder would require 5½ inches (13.97 cm) of linear watering space. But it is not just linear space. The water must be available to the animal while they are in attendance at the waterer. Under heat stress conditions, the system needs to deliver a minimum of 1.1% of body weight per hour; for a 1000 lb (453.6 kg) animal, this means 11 lb (5 kg)/hr, or about 1 1/3 gal (5.03 L)/hr. Ideally, a water system should be capable of delivering within a four-hour period, the amount of water required for an entire day's needs. This can be calculated from line diameter and line pressure. These calculations should always be performed before installing new watering systems. Check flow rates on automatic water tanks in existing facilities. The gallons per minute a waterer can deliver can be estimated by using a rubber tube to divert from the waterer-input orifice (controlled by the float) into a bucket. Divert the water for 30 seconds and estimate the gallons that would have been delivered per minute. If deficiencies are identified in total supply or delivery at peak demand periods, additional supply and/or waterers must be added when temperatures are in the critical range. Alternatively, the cattle can be spread out to more pens so that the existing water supply can better serve critical needs. A bunk lined with a plastic tarp and sand bags on both ends of the tarp will create a temporary, emergency water trough. Do whatever is needed to make all the water cattle need available.

Make arrangements for emergency water. Contact the local fire department or cooperative to access equipment that can deliver emergency water. Make sure livestock drinking water is safe and palatable. Large volume sprinklers can be installed if water supply is adequate. Sprinklers can effectively keep cattle below their upper critical temperature by increasing evaporative cooling and lowering ground temperature. Coverage of 10 to 15 square feet (0.9 to 1.4 square m) per head should be adequate. Remember, water requirements can easily double when wetting pens and sprinkling cattle. Plan accordingly.

Move cattle away from windbreaks. Windbreaks can be beneficial in the winter, but a detriment in the summer. Identify feedlot areas having limited air movement. If possible, consider abandoning these pens during critical heat stress. At least avoid feeding cattle in these pens that are projected to finish in summer or early fall.

Improve airflow in pens. Identify heavy, finished cattle and newly arrived high-risk cattle in the feedlot and give these pens special attention in regard to airflow. Cut tall vegetation 150 feet (45.72 m) back from the perimeter of the pens. If possible, you may consider moving these cattle to shaded pens or pens with better

wind flow. Consider building earth mounds in feedlot pens. Mounds, the taller the better, help prevent cattle from bunching and will usually enhance cattle exposure to air movement. Cattle use them like bleachers in that every animal finds a spot that minimizes the air-flow blockage by an adjacent animal.

Provide shade. Shade reduces exposure to solar radiation, thereby reducing heat load on the animal; it does not affect air temperature. Major design considerations for shade structures are orientation, space, height, and roof construction. The most effective orientation is east-west to keep ground under shade cool; however, a north-south orientation will minimize mud buildup under the shade. With east-west orientation, a higher percentage of shadow lies under the shade structure than when a north-south orientation is used. The shade structure should provide approximately 20 to 40 square feet (1.86 to 3.72 square m) of floor space per feedlot animal recognizing that few production benefits will be realized if animals are overcrowded. For emergency situations to reduce mortality risks, 15 to 25 square feet (1.39 to 2.32 square m) per head can be beneficial. Shade height should be in the range of seven to 14 feet (2.13 to 4.27 m), keeping in mind that the higher the shade, the greater the air movement under the shade. To enhance natural ventilation in shade structures, the selected site should have minimal trees, other buildings, or obstructions within at least 50 feet (15.24 m) of all sides. Various types of roofing materials can be used for shade structures. The most effective in terms of reducing heat load is a reflective roof such as white-painted galvanized or aluminum metal. Slats, plastic or other shade materials with less than total shading capabilities are less effective. Shade structures need to be designed to handle winter snow loads to minimize maintenance and upkeep. The improved gain and growth performance that result from providing shade seldom justify the cost of construction and wind-related maintenance costs. However, there is some improvement in performance, and when considered along with the insurance against mortalities that the structures provide, the cost of construction and maintenance may be justified.

Control biting flies. Stable flies cause cattle to bunch and disrupt animal cooling. Removing weeds and brush within 150 feet (45.72 m) of pens and spraying the shaded areas of buildings with a residual insecticide will help control stable flies. Minimizing shallow pools of water or muddy areas around the feedlot will aid in eliminating breeding areas for flies.

Look for the Clues to an Impending Heat Stress Crisis

Combined heat and lack of cooling (little or no wind and little night cooling)

- Temperature-Humidity Index (THI) above 84 (Heat Index (HI) above 100)
- Wind below 5 MPH (the THI decreases about 1 unit per 1 MPH wind)
- Little night cooling (THI stays above 70)
- Dark or black hided cattle

First Clue: Predicted hot weather following precipitation. It is the combined temperature and humidity that determines the severity of heat stress. Days in the high 80's or 90's (°F) following a precipitation event can be extremely stressful, especially if the wind speed is below 5 miles per hour for extended periods of the day.

Second Clue: Monitor the upper critical temperature-humidity limits of cattle. Consider this limit has been reached when the Temperature-Humidity Index reaches 80 (see the THI chart included).

Third Clue: Evening weather forecast for overnight temperatures to remain above 73°F (22.5°C). A potential heat stress crisis situation exists for cattle when there is little or no night cooling. Watch for days following nights in which the ambient temperatures do not drop below 70°F (21.1°C). Feedlot losses have been commonly reported when three or more consecutive days with Temperature-Humidity Index values above 80 have been tied together with nights in which the temperature stayed above 70°F.

Fourth Clue: Observing cattle will tell you when they are becoming uncomfortable from heat. The cattle will start to move ... walk around the pen looking for an area of the pen that is more comfortable. They will start to slobber and their respiratory rate will increase above 75 breaths per minute. They will begin to elevate their head to make it easier to breathe. They will position their body to minimize their exposure to the sun, generally facing the sun.

Activate emergency plans when temperatures combined with humidity are forecast to be in the critical range for livestock. During a heat wave, the first calm wind day can be lethal to cattle. If your resources are limited, focus on managing heat stress for those cattle that may be most susceptible to heat stress. These include cattle with dark hides, cattle on all-natural feeding programs, cattle close to being finished, newly arrived high-stress cattle, and cattle suffering from illness or recovering from illness.

Remember Human Safety

Maintaining feedlot personnel health during a heat crisis is critical. Without optimum output from person-

nel, the checklist items can't be accomplished. These recommendations are for personnel doing reasonably strenuous outdoor work when temperatures are in the critical range.

Minimize strenuous work during hotter times of the day or at least alternate between hard and light work. If personnel must do hard work, take a break each hour by spending 10 to 20 minutes doing less strenuous work, preferably in the shade.

Force water consumption. Drink one to two quarts (0.95 to 1.89 L) of water per hour.

A buddy system should be used to make sure adequate water is consumed, workload alternates between strenuous work with periods of light work, and early signs of heat exhaustion are detected. Signs of heat exhaustion include mood changes, emotional responses, and confusion.

If a person gets overheated, he or she should not return to strenuous work that day. Inside work or taking the rest of the day off is advisable. Failure to do this may result in the person developing heat stroke.

Heat Stress Management Review

- Post the THI or HI table; in hot weather, evaluate the weather forecast against the THI or HI table every evening and morning.
- Start emergency measures when a sequence of hot days occurs with little or no night cooling (night temperatures stay above 70).
- Schedule cattle handling between midnight and 8 am. Never handle after 10 am when the above two bullet points have been observed.
- Insure cattle have adequate water and watering space in critical heat stress emergency.
- Evaluate water flow-rate and place extra waterers in each pen if needed.
- Improve airflow by reducing or eliminating tall vegetation in and around the feedlot. Abandon pens with wind "dead spots".
- Place shade and/or sprinklers in problem pens and consider installing in all pens.
- Shift daily feed delivery schedule toward evening feeding.
- Reformulate ration to lower the energy content by 5 to 7% or lower total feed intake to minimize overall metabolic heat load.

Temperature Humidity Index (THI)

Normal <74 Alert 75-78 Danger 79-83 Emergency >84

THI	Temp																		
RH	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
90	81	82	83	84	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98
85	80	81	82	83	84	85	86	86	87	88	89	90	91	92	93	94	95	96	97
80	79	80	81	82	83	84	85	86	86	87	88	89	90	91	92	93	94	94	95
75	79	80	80	81	82	83	84	85	86	86	87	88	89	90	91	92	93	93	94
70	78	79	80	81	81	82	83	84	85	86	86	87	88	89	90	91	91	92	93
65	77	78	79	80	81	81	82	83	84	85	85	86	87	88	89	89	90	91	92
60	77	78	78	79	80	81	81	82	83	84	85	85	86	87	88	88	89	90	91
55	76	77	78	78	79	80	81	81	82	83	84	84	85	86	87	87	88	89	90
50	75	76	77	78	78	79	80	80	81	82	83	83	84	85	86	86	87	88	88
45	75	75	76	77	78	78	79	80	80	81	82	82	83	84	85	85	86	87	87
40	74	75	75	76	77	77	78	79	79	80	81	81	82	83	83	84	85	85	86
35	73	74	75	75	76	77	77	78	79	79	80	80	81	82	82	83	84	84	85
30	73	73	74	75	75	76	76	77	78	78	79	80	80	81	81	82	83	83	84
25	72	73	73	74	74	75	76	76	77	77	78	79	79	80	80	81	82	82	83

THI > 84 = Emergency

Temperature Humidity Index (THI) = THI = F-(0.55-(0.55*(RH/100)))*(F-58)

Heat Index

HI	Temp																		
RH	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
90	91	95	98	102	105	109	113	117	122	126	131	136	141	147	152	158	164	170	176
85	90	93	96	99	102	106	110	113	117	122	126	130	135	140	145	150	155	161	167
80	89	91	94	97	100	103	106	110	113	117	121	125	129	134	138	143	148	153	158
75	88	90	92	95	97	100	103	106	109	113	116	120	124	128	132	136	141	145	150
70	86	88	90	93	95	98	100	103	106	109	112	116	119	123	126	130	134	138	143
65	85	87	89	91	93	95	98	100	103	105	108	111	114	118	121	125	128	132	136
60	84	86	88	89	91	93	95	97	100	102	105	107	110	113	116	119	123	126	129
55	84	85	86	88	89	91	93	95	97	99	101	104	106	109	112	114	117	120	124
50	83	84	85	86	88	89	91	93	95	97	99	101	103	105	108	110	113	115	118
45	82	83	84	85	87	88	89	91	92	94	96	98	100	102	104	106	109	111	114
40	81	82	83	84	85	87	88	89	91	92	94	95	97	99	101	103	105	107	109
35	81	82	83	84	85	86	87	88	89	90	92	93	95	96	98	100	102	104	106
30	80	81	82	83	84	85	86	87	88	89	90	92	93	94	96	97	99	101	102
25	80	81	82	82	83	84	85	86	87	88	89	90	91	93	94	95	97	98	100

HI > 100 = Emergency

Heat Index (HI), or apparent temperature (ATI) = HI =
-42.379 + 2.04901523*F +10.14333127*RH - 0.22475541*F*(RH) - 0.00683783*F^2- 0.05481717*RH^2 + 0.00122874*F^2*RH + 0.00085282*F*RH^2 - 0.00000199*F^2*RH^2