HEAT STRESS: It pays to have a strategy.

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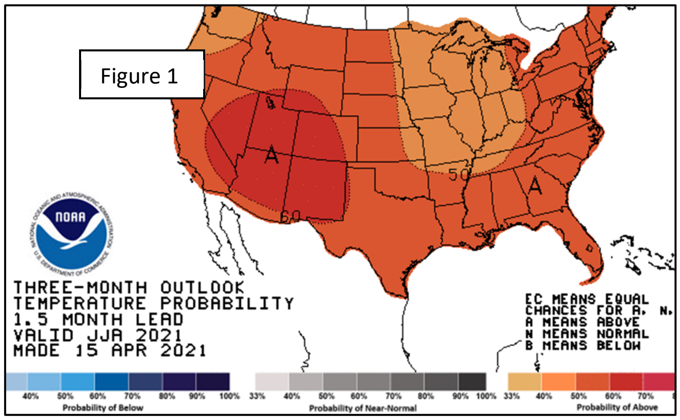
In July of 1999 in northeast Nebraska, during an exceptionally hot and humid period, more than 5,000 head of feedlot cattle perished.[1] In today's dollars that would have been >$7 million in death loss in a very short period from a heat event. It was estimated that producers from that event lost another $21.5-$35 million in lost performance (gain) in those cattle that survived. In July 2010, central Kansas, more than 2,000 head of fed cattle perished during an exceptionally hot and humid period.[2] There are numerous other incidents of the tragic losses in feedlot cattle from heat stress.

In the U.S., economic losses from heat stress in fed cattle were estimated >$365 million over the summer heat season.[3] That estimate is from 17 years ago. Currently, it is probably closer to $500 million considering the value of harvest ready cattle in 2003 was $75-$80/cwt vs $115-$120/cwt today.

Predicting and Measuring Heat Stress

The average U.S. livestock heat season in the Midwest and Central plains is usually from May to October. The warmest months usually occur within the June to September period. The National Oceanic and Atmospheric Administration (NOAA) Climate Prediction Center[4] has forecasted a 50-60% probability of hotter than normal temperatures throughout the primary cattle feeding states June – August 2021 (Figure 1).

Figure 1



Using NOAA Weather Service data and the USDA ARS smart-phone Heat Stress Forecast App[5] provides predictive and current heat stress forecasts which can be invaluable in the implementation of a feedyard heat stress strategy. Mesonet weather networks, like those provided by Kansas[6] and Oklahoma[7], utilize real-time heat stress data.

The most common method utilized to measure heat stress in cattle is the Temperature-Humidity Index (THI). The THI is calculated as follows:

$$THI = 0.8*T + RH*(T-14.4) + 46.4$$

where T = ambient or dry-bulb temperature in °C and RH=relative humidity expressed as a proportion, i.e. 75% humidity is expressed as 0.75.

Example: 86 F and 70% humidity is an 81 THI – this is in the danger zone. Any THI >74 puts cattle on ALERT status. The chart in Figure 2 is published on many livestock websites along with additional information on heat stress.[8]

Beef Cattle Temperature Humidity Chart

Temperature (°F)	Relative Humidity (%)											
	30	35	40	45	50	55	60	65	70	75	80	85
100	84	85	86	87	88	90	91	92	93	94	95	97
98	83	84	85	86	87	88	89	90	91	93	94	95
96	81	82	83	85	86	87	88	89	90	91	92	93
94	80	81	82	83	84	85	86	87	88	89	90	91
92	79	80	81	82	83	84	85	85	86	87	88	89
90	78	79	79	80	81	82	83	84	85	86	86	87
88	76	77	78	79	80	81	81	82	83	84	85	86
86	75	76	77	78	78	79	80	81	81	82	83	84
84	74	75	75	76	77	78	78	79	80	80	81	82
82	73	73	74	75	75	76	77	77	78	79	79	80
80	72	72	73	73	74	75	75	76	76	77	78	78
78	70	71	71	72	73	73	74	74	75	78	76	76
76	69	70	70	71	71	72	72	73	73	74	72	75

Temperature Humidity Index (THI)

Figure 2

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

Economic Losses with Heat Stress

In 2003 there was a comprehensive research project that examined the economic loses of heat stress on U.S. livestock industries.[9] The research examined the dairy industry, beef cows, finishing cattle, swine and poultry. The project demonstrated >$2.4 billion in annual losses across all industries. If heat abatement strategies were employed it reduced the annual losses to $1.7 billion – regardless, a big number, and undoubtedly bigger today. We have applied the equation models to current-day projected heat stress financial losses to fed cattle. The full detail on the livestock models are presented in the cited research[9].

The research demonstrated three measurable financial losses presented due to heat stress in fed cattle per year. We apply the finishing model to the heat stress season. The research uses various integrals and functions of the Temperature-Humidity Index (THI) in the models. These losses are described as:

- Loss of dry matter intake (**DMI**Loss), Kg/animal
  - Equation: $DMI_{Loss} = 9.1 \times 0.032 \times THI_{Load}/100$
    - Average THI_{Load} for finishing cattle = 10,190 (top 12 states for fed cattle)

- Loss of Daily Gain (**GAIN**Loss), Kg/animal
  - Equation: $GAIN_{Loss} = 1.36 \times 0.064 \times THI_{Load}/100$

- Death Loss (DEATH)
  - 0.155% (average of the top 12 states for fed cattle)

For our discussion the first is apportioned to the commercial feedyard; the next two are apportioned to the cattle feeder (seasonal basis).

A. Lost revenues to the feedyard:

Commercial feedlots are in the business of selling feed to their cattle feeder clients. The feed margins generated (markup) offset the costs associated with feeds and feeding cattle. Some feedyards use feed markup and daily yardage fees, and some just use a feed markup and no yardage fee to cover overhead.[10] This discussion is based on feed markup as the primary source of revenue to the feedyard to cover overhead and maintain a profit.

The math:

Loss of Dry Matter Intake, DMI_{Loss}

Calculation: $DMI_{Loss} = 9.1 \times 0.032 \times 10{,}190/100$

DMI_{Loss} = 29.67 Kg x 2.2 lbs/Kg = 65.3 lbs DM Intake Loss

For our example: the average finishing ration dry matter = 63%;

Average finishing ration cost (as fed) = $235/ton, $0.1175/lb

Total Lost Revenue/head = 65.3 lbs DM/63%DM = 103.7 lbs feed (as-fed) x $0.1175/lb = **$12.18/hd**

Impact: In a 45,000 hd yard, with all cattle present in the heat stress season, with no abatement or mitigation of heat stress, this model equates to >$540,000in projected reduced feed sales. If the average markup were 15%, the Gross Margin loss is >$82,000.

If feed markup ranges from 13-18%, Table 1 shows the potential feedyard Gross Margin Losses from reduced dry matter intakes.

Table 1: Gross Margin Feed Sales Revenue Loss from Weather (Heat Stress)/Season						
Feed Markup	13.00%	14.00%	15.00%	16.00%	17.00%	18.00%
Capacity(hd)						
10000	($15,833)	($17,051)	($18,268)	($19,486)	($20,704)	($21,922)
20000	($31,665)	($34,101)	($36,537)	($38,973)	($41,408)	($43,844)
25000	($39,582)	($42,626)	($45,671)	($48,716)	($51,761)	($54,805)
30000	($47,498)	($51,152)	($54,805)	($58,459)	($62,113)	($65,766)
35000	($55,414)	($59,677)	($63,940)	($68,202)	($72,465)	($76,728)
40000	($63,331)	($68,202)	($73,074)	($77,945)	($82,817)	($87,689)
45000	($71,247)	($76,728)	($82,208)	($87,689)	**($93,169)**	($98,650)
50000	($79,163)	($85,253)	($91,342)	($97,432)	($103,521)	($109,611)
55000	($87,080)	($93,778)	($100,476)	($107,175)	($113,873)	($120,572)
60000	($94,996)	($102,303)	($109,611)	($116,918)	($124,225)	($131,533)

Breaking this down further, Table 2 shows potential losses for the 12 major states for finishing cattle in the research project.

Table 2: Potential Revenue Losses in 12 major states for finishing cattle.							
	Var1	9.1	DM%	63.00%		**Lost Feed**	**Lost Feed**
	Var2	0.032	Feed cost/lb	$ 0.1175		**Revenue**	**NET w/**
					Lost	**45000**	**15.00%**
	THILoad	**Kg DMI**Loss	**lbs. DMI**Loss	**lbs. As-Fed**	**Revenue/Hd**	**hd Yard**	**Mark-up**
TX	19778	57.59	126.71	201.12	$ 23.63	$ 1,063,424	$ 159,514
OK	14904	43.40	95.48	151.56	$ 17.81	$ 801,358	$ 120,204
AZ	8758	25.50	56.11	89.06	$ 10.46	$ 470,900	$ 70,635
NM	8037	23.40	51.49	81.73	$ 9.60	$ 432,133	$ 64,820
KS	8015	23.34	51.35	81.50	$ 9.58	$ 430,951	$ 64,643
NE	7800	22.71	49.97	79.32	$ 9.32	$ 419,390	$ 62,909
IA	5891	17.15	37.74	59.90	$ 7.04	$ 316,747	$ 47,512
SD	5830	16.98	37.35	59.28	$ 6.97	$ 313,467	$ 47,020
CA	3812	11.10	24.42	38.76	$ 4.55	$ 204,964	$ 30,745
CO	2493	7.26	15.97	25.35	$ 2.98	$ 134,044	$ 20,107
WA	2139	6.23	13.70	21.75	$ 2.56	$ 115,010	$ 17,251
ID	1577	4.59	10.10	16.04	$ 1.88	$ 84,792	$ 12,719
	Weighted						
Average	10190	29.67	65.28	103.62	$ 12.18	$ 547,896	$ 82,184

Implementing a feedyard Heat Stress Strategy to maintain feed intakes makes economic sense when feed markups are used to cover overhead. This is especially true if the feedyard can reduce this lost revenue by 50% or more.

B. Lost Revenue to the Cattle Feeder

Cattle feeding profitability can be elusive and at times, very high risk. The cattle feeder looks to the commercial feedyard to maintain optimum performance, health programs, and assist with risk management practices. The cattle feeder relies on the expertise within the feedyard management, pen riders, and professional staff to implement these programs for the welfare of their cattle.

The math:
Heat Stress Model for the average **Loss of Gain, $GAIN_{Loss}$**
Calculation: $GAIN_{Loss}$ = 1.36 x 0.064 x 10,190/100
$GAIN_{Loss}$ = 8.87 Kg x 2.2 lbs/Kg = 19.51 lbs Lost Gain

Based on the average value of a 750# feeder steer at $1.45/lb and a market ready 1250# steer at $1.20/lb, the average value of gain is $1.294/lb.
Direct Cost / head (Gain) = 19.51 lbs gain x $1.294/lb = **$25.25/hd**

DEATH Loss: per the cited research, the top 12 feeder cattle states average 1.55/1000 head in death loss from heat stress = 0.155% Death Loss

22 million head harvested/yr 0.155% = 34,100 head death loss from heat stress related issues.
Average weight = 1000# and average value = $1.294/lb = $1294 average value of dead animal.
Direct Cost / head (Death Loss) = $1294 x 0.155% = **$2.01/hd**

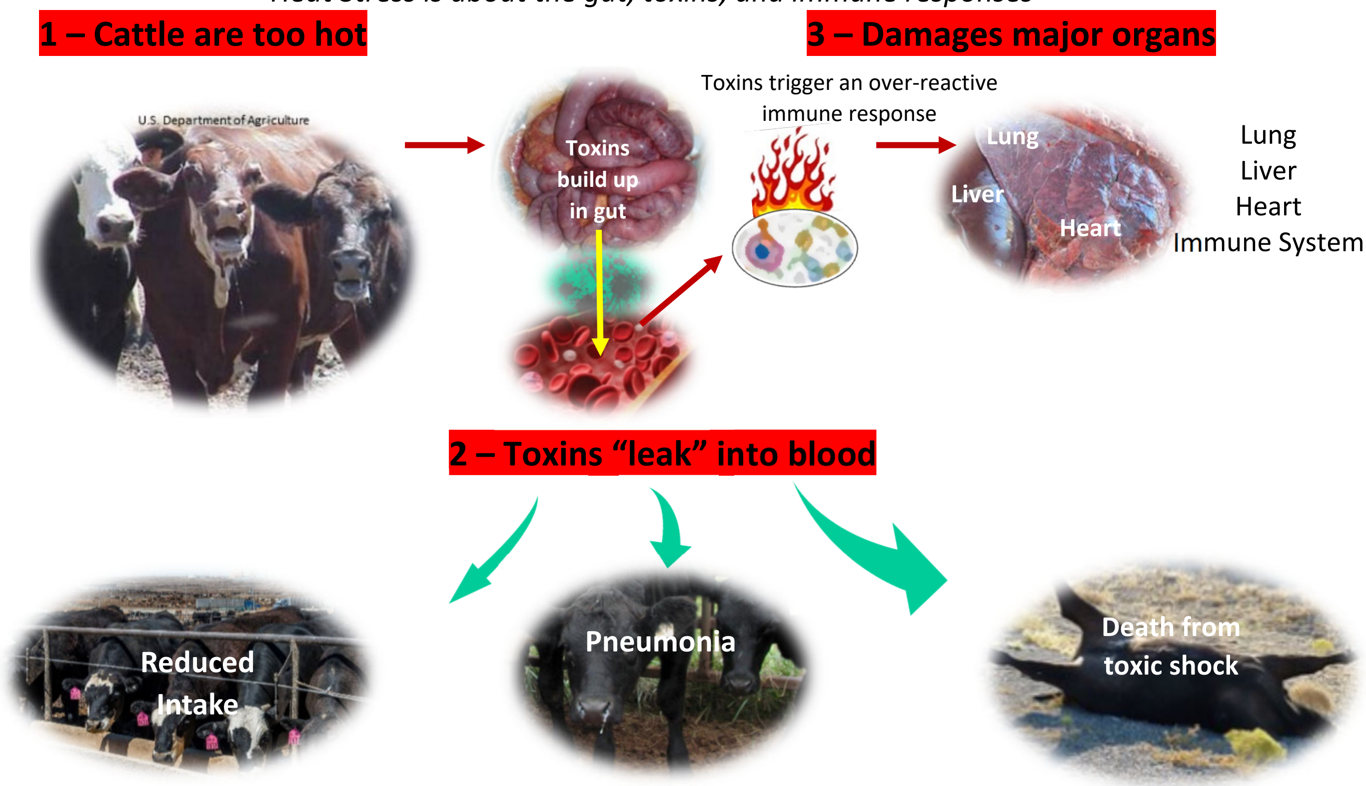
Direct Cost / hd from loss of gain and death loss = $25.25 + $2.01 = **$27.26/hd**

Impact: For a pen of 120 head during the heat stress season with no abatement or mitigation Heat Stress Strategy has an additional potential average loss >$3200 for the pen. Implementing a feedyard Heat Stress Strategy to maintain performance and reduced death loss makes economic sense for the benefit of the cattle feeder. This is especially true if the cattle feeder can recover this lost revenue by 50% or more.

Why is Heat Stress so Destructive with Long-lasting Effects?

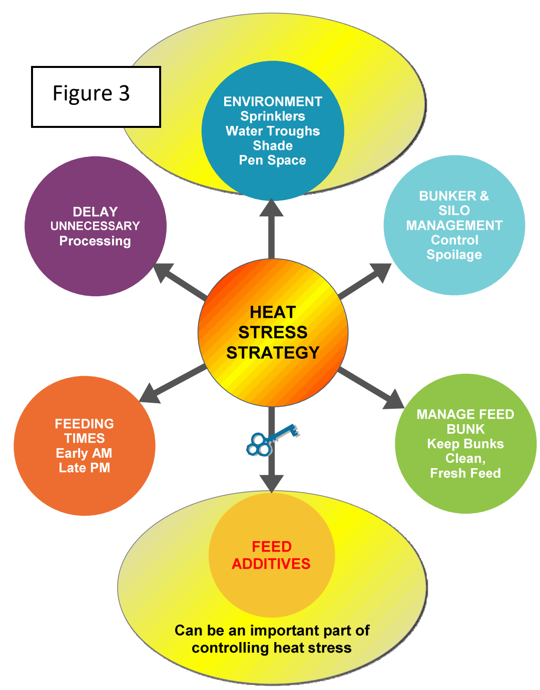
There is a lot of excellent scientific literature on the physiology of heat stress in cattle. It is not our intent to go into this research, but a simple 3-step schematic summary can sum it up.

Heat Stress is about the gut, toxins, and immune responses[11]



Heat Stress Strategy

There is an excellent webinar from the University of Nebraska-Lincoln on handling cattle during heat stress episodes.[12]



There are multiple factors in putting together a Heat Stress Strategy. Figure 3 illustrates many of the important aspects in managing heat stress. Two of the more important factors are:

- Environment
  - Water quality and availability
  - Pen space
  - Sprinklers
  - Shade when possible
- Feed Addives – often overlooked, but the right feed additive may hold the key to a successful Heat Stress Strategy. Table 3 shows product comparisons of the more common feed additives for heat stress mitigation.

Table 3. **Product comparisons of the more common feed additives for heat stress mitigation**					
	Sea Weed	CAPSAICIN	BETAINE	CHROMIUM	B-GLUCANS
Continuous Feeding	✓	✓	✓	✓	**7-Day Pulse**
Antioxidant Properties	✓	✓	✓	✓	✓
Immune System Support				✓	✓
Reduction of body temp	✓	✓	✓	✓	✓
Activates Cellular/Genetic receptors				✓	✓
Osmotic Activity			✓		
Supports Gut Integrity			✓	✓	✓
Preserves Feed Intake					✓
Preserves Performance					✓
Decreases heat related pulls					✓
Improved Treatment response					✓
Supports Vaccine Response during heat stress				✓	✓

Of the products illustrated in Table 3, the beta-glucans have the most research and have a direct impact on the negative physiological factors associated with HEAT STRESS.[13] [14]

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Endnotes

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