DN NEWSLETTER issue 50

HEAT STRESS TELL TALE SIGNS - TACKLING HEAT STRESS TO KEEP ON TRACK.

It's not always easy to pick up heat stress in dairy cows, but there are some subtle hints that could give the game away. And pre-empting problems can keep today's high performance cows on track through the warmer summer months.

Heat Stress – We cannot afford to ignore it

In the UK and Ireland there remains a widespread misconception that heat stress is only a challenge for milk producers in warmer climates. Increasing evidence however shows that even the relatively low summer temperatures here can significantly impact productivity, reproduction, health, and welfare.

It takes minimal effort for a dairy cow to maintain a constant body temperature of approximately 38.8°C when environmental temperatures are between -5 to 25°C. But when temperatures rise beyond this, cows cannot dissipate enough heat from their own body, causing core body temperature to rise and heat stress to occur.

"But on a short-term basis, if we have a spike in temperatures to this sort of level, even for an hour or so, then cow behaviour can be affected. Cows spend more time standing in cooler areas and at water troughs, and respiration rates will increase. There will be fewer cows in cubicle and less time spent ruminating and eating."

"We're encouraging more farmers to install loggers and monitor THI in their cow sheds so they can see a problem coming and prepare ahead. The data is fed into a cloud-based system and is accessible via their smart phones or iPad devices.

Where does this heat come from?

Ruminant animals generate a significant amount of heat during metabolic functions associated with maintenance, reproduction, immune function and lactation, much of which is created in the rumen as a by-product of microbial fermentation.

To put this into perspective, studies have shown that animals yielding 40L of milk per day produce on average 1.61KW of thermal energy, equivalent to the output of a domestic convection heater. For cattle at grass, radiant heat from the sun is also a significant source of heat

How do we measure this?

For housed animals, temperature alone is an insufficient indicator of a cow's heat load. We instead refer to the Temperature Humidity Index (THI), a figure which calculates the combined effect of ambient temperature and relative humidity. Humidity is particularly relevant as it exacerbates the impact of lower temperatures. In grazing herds, radiant heat from the sun amplifies ambient temperatures outdoors, something particularly problematic in dark-coloured animals, therefore a 'black globe' instrument can be used to measure this effect, as well as the impact of wind cooling.

Globally, a THI of 72 is recognised as the threshold for heat stress. However, recent studies have established that extended periods at a THI of just 62 in Northern Europe can induce moderate heat stress, reducing milk yield by up to two litres per day (as shown within table 1). As humidity levels of 80% are not uncommon in our region, temperatures of just 18°C can induce mild levels of heat stress.

Temperature		% Relative Humidity																	
°F	°C	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90
72	22.0	64	65	65	65	66	66	67	67	67	68	68	69	69	69	70	70	70	71	71
73	23.0	65	65	66	66	66	67	67	68	68	68	69	69	70	70	71	71	71	72	72
74	23.5	65	66	66	67	67	67	68	68	69	69	70	70	70	71	71	72	72	73	73
75	24.0	66	66	67	67	68	68	68	69	69	70	70	71	71	72	72	73	73	74	74
76	24.5	66	67	67	68	68	69	69	70	70	71	71	72	72	73	73	74	74	75	75
77	25.0	67	67	68	68	69	69	70	70	71	71	72	72	73	73	74	74	75	75	76
78	25.5	67	68	68	69	69	70	70	71	71	72	73	73	74	74	75	75	76	76	77
79	26.0	67	68	69	69	70	70	71	71	72	73	73	74	74	75	76	76	77	77	78
80	26.5	68	69	69	70	70	71	72	72	73	73	74	75	75	76	76	77	78	78	79
81	27.0	68	69	70	70	71	72	72	73	73	74	75	75	76	77	77	78	78	79	80
82	28.0	69	69	70	71	71	72	73	73	74	75	75	76	77	77	78	79	79	80	81
83	28.5	69	70	71	71	72	73	73	74	75	75	76	77	78	78	79	80	80	81	82
84	29.0	70	70	71	72	73	73	74	75	75	76	77	78	78	79	80	80	81	82	83
85	29.5	70	71	72	72	73	74	75	75	76	77	78	78	79	80	81	81	82	83	84
86	30.0	71	71	72	73	74	74	75	76	77	78	78	79	80	81	81	82	83	84	84
87	30.5	71	72	73	73	74	75	76	77	77	78	79	80	81	81	82	83	84	85	85
88	31.0	72	72	73	74	75	76	76	77	78	79	80	81	81	82	83	84	85	86	86
89	31.5	72	73	74	75	75	76	77	78	79	80	80	81	82	83	84	85	86	86	87
90	32.0	72	73	74	75	76	77	78	79	79	80	81	82	83	84	85	86	86	87	88
91	33.0	73	74	75	76	76	77	78	79	80	81	82	83	84	85	86	86	87	88	89
92	33.5	73	74	75	76	77	78	79	80	81	82	83	84	85	85	86	87	88	89	90
93	34.0	74	75	76	77	78	79	80	80	81	82	83	85	85	86	87	88	89	90	91
94	34.5	74	75	76	77	78	79	80	81	82	83	84	86	86	87	88	89	90	91	92
95	35.0	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93
96	35.5	75	76	77	78	79	80	81	82	83	85	86	87	88	89	90	91	92	93	94
97	36.0	76	77	78	79	80	81	82	83	84	85	86	87	88	89	91	92	93	94	95
98	36.5	76	77	78	80	80	82	83	83	85	86	87	88	89	90	91	92	93	94	95
99	37.0	76	78	79	80	81	82	83	84	85	87	88	89	90	91	92	93	94	95	96
100	38.0	77	78	79	81	82	83	84	85	86	87	88	90	91	92	93	94	95	96	98
101	38.5	77	79	80	81	82	83	84	86	87	88	89	90	92	93	94	95	96	98	99
102	39.0	78	79	80	82	83	84	85	86	87	89	90	91	92	94	95	96	97	98	100
103	39.5	78	79	81	82	83	84	86	87	88	89	91	92	93	94	96	97	98	99	101
104	40.0	79	80	81	83	84	85	86	88	89	90	91	93	94	95	96	98	99	100	101
105	40.5	79	80	82	83	84	86	87	88	89	91	92	93	95	96	97	99	100	101	102
106	41.0	80	81	82	84	85	87	88	89	90	91	93	94	95	97	98	99	101	102	103
107	41.5	80	81	83	84	85	87	88	89	91	92	94	95	96	98	99	100	102	103	104

THI = (Tdb-(0.55-0.55*RH/100)*(Tdb-58) where Tdb is dry bulb temperature (°F) and RH is relative humidity • °C = (°F – 32)/1.8)

(Zimbelman and Collier, 2011)

Stress Threshold: Respiratory rate exceeds 60/min. Milk yield losses begin. Reproduction loses detectable. Rectal temperature exceeds 38.5°C

Mild-Moderate Stress: respiratory rate exceeds 75/min. Rectal temperature exceeds 39°C

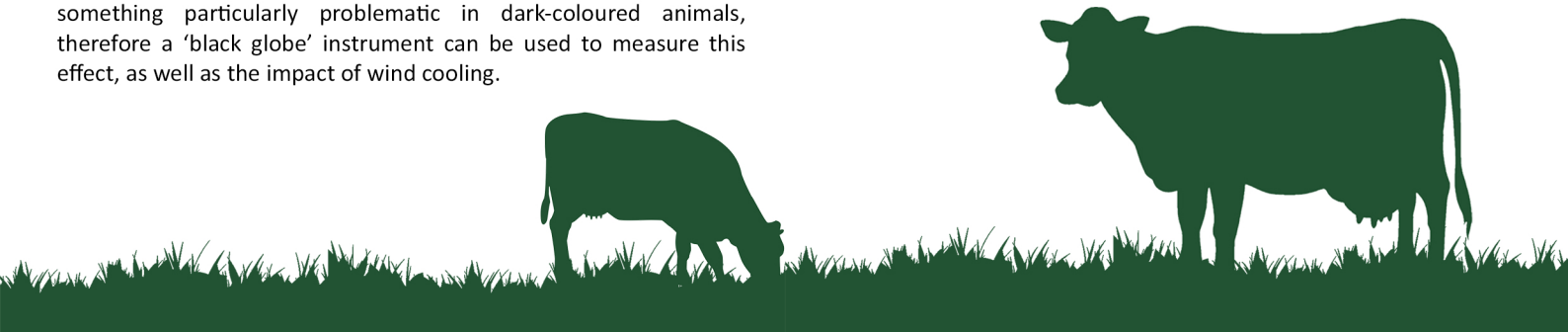
Moderate-Severe Stress: respiratory rate exceeds 85/min. Rectal temperature exceeds 40°C

Severe Stress: respiratory rate is 120-140 /min. Rectal temperature exceeds 41°C

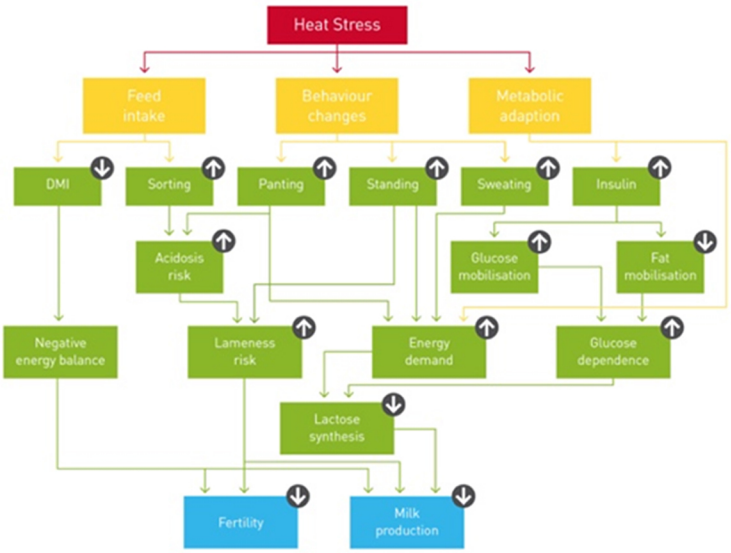
In addition to climatic conditions, several environmental, genetic, and management factors can contribute to heat stress. The heat load is greater for example in high yielding animals, due to an increased metabolic rate. In comparison to a dry cow, a lactating cow will produce 28% more heat at 18 litres per day and 48% more at 31 litres. Additionally, heat dissipation is reduced where stocking rates are too high within housing and where ventilation is poor.

Assessment	THI Score	Estimated milk loss (Litres/day)
None	<62	0
Moderate	62-72	0 to 2
High	73-79	2 to 4
Severe	80<	4 +

Table 1: The impact of heat stress on productivity (Hammemi, 2013)



What is the result?



When such conditions challenge cows, they employ two strategies to maintain thermal balance:

1. Release more heat from their body (heat dispersion), primarily through evaporation by increasing subcutaneous blood flow, panting and drooling. Respiration rate is especially important and will rise significantly, as cattle have a relatively limited number of sweat glands.

2. Limit heat production by reducing all activity and altering their feeding patterns. This ultimately reduces Dry Matter Intake (DMI) by 10-30% to lower the heat produced by fermentation in the rumen.

As energy availability decreases and metabolism alters, the cow enters a negative energy balance. This leads to lower milk yields and milk solids, poorer expression of heat, reduction of egg (oocyte) quality, and an increased risk of both lameness and mastitis. Where animals are in mid to late-gestation, moderate and severe cases of heat stress can affect the calf in utero, negatively impacting further generations of the herd even before birth.

Aside from the alteration in feed intake, rumen function becomes significantly challenged by the increase in panting and drooling. A cow's respiration rate is usually around 20 breaths per minute, however at a THI of 73, this is approximately 90 breaths per minute. As respiration rate rises, cudding rate falls and so saliva output is reduced, whilst at the same time drooling increases saliva loss. Saliva is a key source of bicarbonate, a natural buffer that helps maintain rumen pH at around 6.3, making heat stress a significant risk factor for acidosis.

Cattle experiencing heat stress become visibly lethargic, stand for extended periods with a bowed head and invest more time in drinking. This significant increase in standing time has been anecdotally linked to an increase in solar ulcers, something that becomes apparent 2-3 months later. Respiration rates rapidly increase from 20-40 breaths per minute to over one per second, and where ventilation is poor, fresh air seeking behaviour is visible at gates.

Rumen function is also challenged and so acidosis becomes visible as dung becomes loose and rumen fill reduces. When grazing, cattle seek shade to lower their exposure to the sun, leading to overcrowding under trees when cover is limited. Whilst lowering the heat load from solar radiation, this leads to an increase in localised humidity, due to the concentrated distribution of urine, and a reduction in heat loss capacity through evaporation.

What can be done?

• Ensure that cattle have an adequate supply of cool (<20°C) and fresh water, with 10cm of trough space per head available to maintain access.

• Improve ventilation by 'opening up' sheds and/or utilising fans or ventilation tubes – Start with the collecting yard first and aim for an airflow of 3-4m/s. A 1m wide fan can project air 10m, so many may be required in a chain to cover a whole shed. While many are provided with a grill or mesh, it is best to leave fans open as collection of dust overtime will reduce their effectiveness. It is estimated that for every 1m/s increase in airflow, the THI of a shed drops by 1.99.

• For grazing cattle, provide adequate shade – 4-6m2 per animal is recommended, however this may be unachievable for many. For every 100W/m2 decrease in solar radiation, THI is decreased by 0.68.

• Compensate for minerals lost through drooling and sweating – sodium, potassium and magnesium are minerals to watch.

• Counter the loss of DMI & maximise rumen function:

  o Increase the diet nutrient density
  o Feed rumen protected fat
  o Feed more often and at night to avoid secondary fermentation at higher temperatures
  o Keep feed pushed up to avoid sorting
  o Feed sources of highly digestible structural fibre to counter aci dosis and reduce heat production
  o Feed bypass protein to make up for the reduction in microbial protein production due to lower intakes and fermentable energy levels
  o Provide chemical buffers to maintain rumen pH
  o Consider feeding Niacin (Vitamin B3), proven to improve heat tolerance by helping cows better regulate their body temperature
  o Feed Actisaf® live yeast

Research has shown that feeding Actisaf® during risk periods is significantly beneficial:

• Minimising the risk of acidosis

• Improving feed digestion and feed efficiency

• Supporting higher levels of DMI

• Increasing plasma Niacin, a natural by-product of microbial fermentation, and blood glucose levels through improved rumen function

• Supporting higher milk yields and milk constituents

Dugdale Nutrition

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