

# Strategies to Reduce Heat Stress in Dairy Cows

## Dairy Barn Cooling Factsheet Series

### Key points

- Heat stress causes loss in milk production, lower reproduction rates, lameness and in extreme circumstances, death
- Heat stress occurs at a Temperature Humidity Index (THI) above 68
- Heat stress is evident when a cow exceeds 60 breaths per minute (BPM)
- Increasing air speed over the cows (convective cooling) is the most effective means of reducing heat stress
- A Minimum Cooling Air Sped (MCAS) of at least 1 m/s (200 fpm) at the cow's resting height is required to reduce heat stress but an increase to 2 m/s (400 fpm) will be more effective at higher THI
- Evaporative cooling is effective and should be used along with increased air speed at higher THI experienced in the Fraser Valley

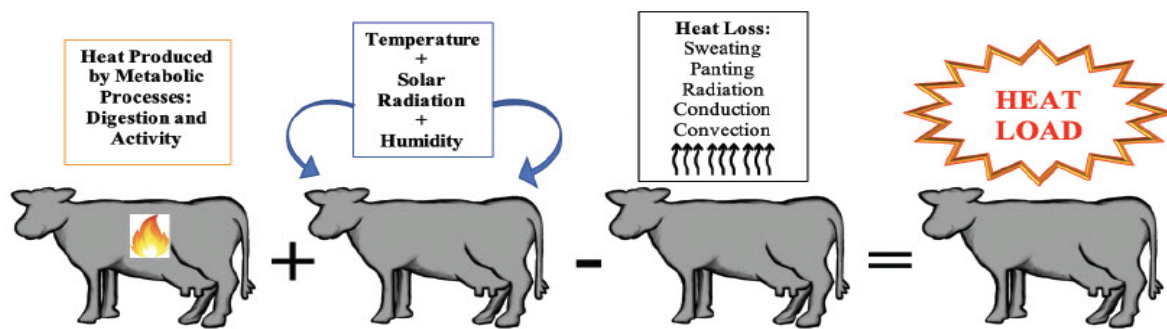
### Introduction

Heat stress is an issue facing all dairy producers. Never was this more evident than during the heat dome experienced in the summer of 2021. Heat stress causes loss in milk production, lower reproduction rates, and lameness, and in extreme circumstances can even result in the death of a dairy cow. Fortunately, the negative effects of heat stress can be reduced by implementing effective ventilation and cow cooling strategies. Cow cooling is becoming more important as cows continue to produce more milk and therefore generate more heat. As summer temperatures rise, it becomes harder for cows to get rid of excess body heat.

### What is heat stress?

Heat stress occurs when the heat produced by a dairy cow's biological processes and the heat the cow absorbs from the environment exceeds the cow's capacity to dissipate heat (Figure 1). To try to maintain body temperature a heat stressed cow will:

- Increase sweating and breathing rate to transfer more heat to the environment through evaporation
- Reduce feed intake to decrease the amount of heat she generates
- Stand for longer periods of time to increase her surface area to dissipate heat
- Seek shade and/or increased air flow which sometimes results in standing in bunches



**Figure 1.** Heat stress occurs when the heat gained by the cow exceeds the heat lost. Recognizing Heat Stress in Dairy Cattle. 2019. Department of Animal Sciences. UF/IFAS

These behaviours have a variety of both immediate and delayed negative consequences such as:

- Immediate and delayed reduction in dry matter intake (DMI) and milk production
  - Heat stressed dry cows will produce less milk in the subsequent lactation
  - Calves, and their subsequent offspring, born to heat stressed dams will have reduced growth and reduced milk production years later
- Impaired immune system
- Immediate and delayed reduction in reproduction
- Lameness due to increased standing
- Acidosis due to slug feeding, which occurs when the pH in the cow's rumen drops too low

## Temperature Humidity Index (THI) as an indicator of heat stress

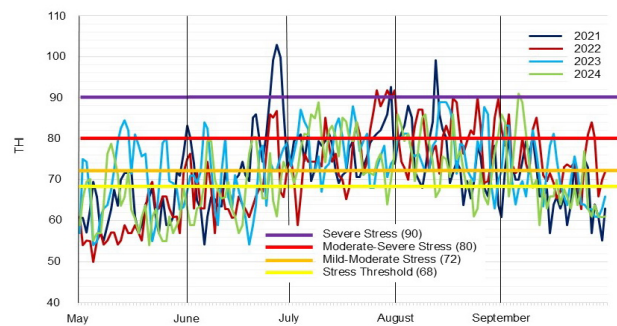
The rate at which heat can be transferred through convection depends on the temperature difference between the air and the cow's hide. The rate at which evaporation can transfer heat also depends on the relative humidity (%RH). Consequently, both high temperatures and high humidities slow the dissipation of heat from the cow and contribute to heat stress.

To quantify the level of heat stress caused by the combined effects of temperature and %RH, the temperature humidity (THI) was developed. Figure 2a shows a table of temperature and humidity values and their heat stress effect on dairy cows. Heat stress starts to occur at values of 68 and higher. Figure 2b shows a graph of the THI calculated for Abbotsford from 2021 through 2024. It's clear that heat stress has become a serious concern.

Air Temp		Relative Humidity (%)							
°C	°F	20	40	50	60	70	80	90	100
42	108	86	91	94	97	99	102	105	108
40	104	84	89	91	94	96	99	101	104
38	100	82	86	89	91	93	96	98	100
36	97	80	84	86	88	90	93	95	97
34	93	78	82	84	85	87	89	91	93
32	90	76	79	81	83	84	86	88	90
30	86	74	77	78	80	81	83	84	86
28	82	72	74	76	77	78	80	81	82
26	79	70	72	73	74	75	77	78	79
24	75	68	70	70	71	72	73	74	75
22	72	66	67	68	69	69	70	71	72
20	68	64	65	65	66	66	67	67	68
18	64	62	62	63	63	63	64	64	64

Stress Threshold (68)      Moderate-Severe Stress (80)  
Mild-Moderate Stress (72)      Severe Stress (90)

**Figure 2a.** Temperature Humidity Index for Dairy Cattle.



**Figure 2b.** THI Calculated for Abbotsford BC from 2021 to 2024.

## What are the signs & symptoms of heat stress?

Dairy cows exhibit heat stress with multiple behavioural changes that can be readily observed as well as symptoms that may be immediate or delayed:

### Symptoms

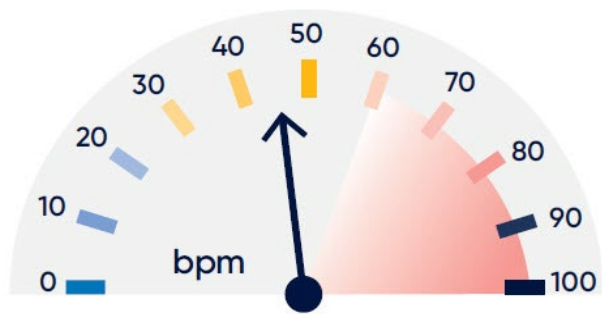
- Drop in feed intake
- Drop in milk production
- Reduced conception rates and signs of estrus (heat)
- Increased lameness
- Increased Somatic Cell Count (SCC)

## Behavioural signs

1. Increased breathing rate
2. Reduced rumination
3. Cows standing
4. Cows bunching

### 1. Increased breathing rate

The respiratory rate for a mature dairy cow is 25 to 50 breaths per minute (BPM). Heat stress is evident when a cow exceeds 60 BPM (Figure 3), and panting occurs at an average of 100 BPM. You can easily check a cow's breathing rate by watching her flank (side) move in and out—each full movement counts as one breath. Use a stopwatch to count. Count the number of breaths in 15 seconds and multiply by 4. Another method is described in detail on the YouTube video: [How to measure respiration rate in dairy cattle](#).



**Figure 3.** Heat stress is evident when a cow exceeds 60 breaths per minute (BPM). Cool Cows. Strategies for managing heat stress in dairy cows. Edition 2. 2023. Dairy Australia.

### 2. Reduced rumination

Rumination or cud chewing is the primary activator of saliva production which is important for rumen buffering. Heat stressed cows ruminate less, producing less saliva. Heat stressed cows tend to eat fewer larger meals (slug feeding). These behaviors contribute to increased risk of rumen acidosis.

### 3. Cows standing

Ideally a cow should lay down at least 12 hours per day. Heat stressed cows stand to increase their surface area to dissipate the heat. Increased time standing puts more pressure on their feet which can result in increased lameness.

#### 4. Cows bunching

Cows stand and bunch together for a number of reasons related to heat stress. They will move to a part of the barn where they feel there is more fresh air. Cows will also bunch in response to light. Cows will sense the sun as adding to their heat stress and try to move out of the light. The other common reason for bunching is flies. Unfortunately, after cows have started to bunch it is difficult to change this behaviour. Once they start, they tend to bunch up even with just a little heat stress. Bunching causes cows to stand on their feet longer than desired and reduces the opportunity to dissipate heat when they are crowded together in a group.

#### What can be done to reduce heat stress?

When the THI rises above 68 or you start to observe some of these behavioural signs, it is time to do something to reduce the effects of heat stress. However, it is much better to prepare ahead of time. Consider reducing heat stress by convective cooling using fans and evaporative cooling using sprinklers. In addition to the use of fans and evaporative cooling, certain building designs and management practices can also help reduce heat stress.

- Maximize natural ventilation
- Maximize sidewall opening
- Provide adequate ridge opening
- Minimize wind shadow
- Convective cooling
- Evaporative cooling
- Manage sun shading
- Curtains and doors
- Insulation
- Roof colour
- Access to water
- Develop a fly control program

## 1. Maximize natural ventilation

### A. Maximize sidewall opening

Maximize the amount of sidewall opening for natural ventilation. If possible, the entire sidewall should be adjustable curtain. It is best to use a split curtain that can be opened completely at cow level in warm weather. In cold weather the bottom curtain can be closed and the top portion adjusted to provide natural ventilation. Use a bird screen with the largest opening size and thinnest fibres that still keep birds out. Avoid screens with wide mesh webbing, as they can significantly reduce airflow.

### B. Provide adequate ridge opening

A suitable ridge opening is a necessary part of a natural ventilation system to exhaust stale air in cold weather and to allow for heat release in hot weather. The amount of opening for a continuous ridge opening usually takes the form of an offset roof line with an adjustable curtain that can be used to reduce the size of opening in colder weather (Figure 4). If chimneys are used, the minimum chimney size is 0.05 m<sup>2</sup> per 9.3 m<sup>2</sup> (0.5 ft<sup>2</sup> per 100ft<sup>2</sup>) of floor area. The maximum size for a chimney is 1.2 m x 1.2 m (4 ft. x 4 ft.) and it is recommended to have at least one chimney for every 185 m<sup>2</sup> (2,000 ft<sup>2</sup>) of floor area.

### C. Minimize wind shadow

Any obstacle upwind can affect airflow for a distance up to 10 times its height downwind. Therefore, buildings that are too close together cannot be naturally ventilated effectively and will require fans.



**Figure 4.** Offset ridge opening with adjustable curtain.

## 2. Convective cooling (increasing air speed)

Natural ventilation doesn't work well during hot weather because there's usually very little wind. Fans are then required to provide convective cooling. Convective cooling involves using fans to increase the air speed over the cow's surface to improve conduction of body heat. Research has shown the importance of having a Minimum Cooling Air Speed (MCAS) of at least 1 m/s (200 fpm) in the free stall area. The MCAS encourages the cows to lay down and rest. The researchers noted that at higher THI the improvement may be greater at higher air speeds. High THI conditions are common in the Fraser Valley. The goal then is to have air moving at least 1 m/s air speed (200 fpm) across 100% of the resting area- but 2 m/s (400 fpm) is preferred.

For more information on convective cooling of cows with supplemental ventilation, see the [Factsheet: Convective Cooling of Dairy Cows to Reduce Heat Stress](#).

## 3. Evaporative cooling

Evaporative cooling involves wetting the cow's body and using body heat to evaporate the moisture and cool the cow. Using fans to speed up evaporation makes evaporative cooling more effective. The priority is to install fans over the free stalls to provide cooling in the resting area, and this encourages them to lay down. In addition to fans over the free stalls, fans mounted over the feed manger increase the rate of evaporative cooling. The most effective way to reduce heat stress is to install fans in both places. However, evaporative cooling is still beneficial even without fans at the feed manger.

Evaporative cooling can also be used to cool the air before it reaches the cows. However, this method becomes less effective when the relative humidity exceeds 60%, which is common in the Fraser Valley.

For more information on evaporative cooling systems see the [Factsheet: Evaporative Cooling of Dairy Cows to Reduce Heat Stress](#).

## 4. Manage sun effects

### A. Provide shade

It is important to provide shade for cows. In a new design, sunlight can be minimized by orientating the ridge of the barn in an east-west direction if possible. In a split curtain design, the top curtain can be closed to reduce heat. In extreme conditions, using a 50% porous shade cloth can also help block sunlight while still allowing some airflow. On hot, still days, closing both curtains can help create a tunnel effect, allowing panel fans to move air more effectively over the cows.

Extending the roof overhang to 1.2 meters (4 feet) helps shade the barn from the sun and keeps rain out—especially important when there are stalls along the outside wall.

### B. Insulation

Several other factors can influence heat stress on dairy cattle, though they may be harder to retrofit. Insulation under the roof steel is important. This can be as simple as a layer of plywood or OSB board. Roll-on batt insulation is more effective, but it requires bird protection. If the barn has a ceiling, adding attic insulation will also reduce the heat load from the sun's radiation.

### C. Roof colour

Roof colour is often chosen for appearance, but it also affects heat gain. A white roof reflects more of the sun's energy compared to any other colour including galvanized steel.

## 5. Water

Although this Factsheet does not deal with nutritional solutions, never underestimate the importance of water during periods of heat stress. Each cow should have access to at least 9 to 10 cm (3½ to 4 inches) of water trough space, with water available at a minimum of two locations per group. Water troughs should be cleaned regularly to remove feed, dirt and debris.

## 6. Fly control

If the fly population is too great, cows will bunch together to try to reduce their surface area that is exposed to the flies. Develop a fly control program with advice from your veterinarian if flies seem to be contributing to the problem. Using sprays, bait, or traps can help. If there is pasture or lawn close to the barn, it should be kept trimmed next to the barn to reduce fly spread. Closing curtains may also help reduce the number of flies.

## Summary

This Factsheet outlines the causes and effects of heat stress on dairy cows. It summarizes the signs of heat stress and the behavioural responses of standing, reduced rumination, panting and bunching as well as the symptoms that occur. It introduces solutions to reduce heat stress. For more information on how to reduce heat stress please refer to [Factsheet Convective Cooling of Dairy Cows to Reduce Heat Stress](#) and [Factsheet Evaporative Cooling of Dairy Cows to Reduce Heat Stress](#). The Factsheet on Ventilation Assessment provides a method of evaluating the effectiveness of the ventilation system in your barn.

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