Heat Stress in Dairy Cows

Brian Tarr, Ruminant Nutritionist
Shur-Gain, Nutreco Canada Inc.
Heat stress has several serious and economically deleterious effects on cattle. The most important effects of heat stress in dairy cows are reduced feed intake, milk production, butterfat percent and lower reproductive performance. Cows require additional energy to dissipate the heat and regulate body temperature. It is imperative to recognize and manage heat stress in two distinct stages.

1. Reduce the amount of heat cows are exposed to and/or accumulate.
2. Change feeding and management to help keep cows cool and/or cool cows more efficiently.

What are the main sources of heat stress?

There are several sources of heat that affect cows and contribute to heat stress.

- The first and probably most important is the heat accumulated by direct radiation from the sun. In addition, dark coat animals accumulate more radiation heat than light or white coat cattle.
- The heat of digestion is an important source of heat accumulation in cows. The heat of digestion of forages is higher than that for grains. Animals on a higher forage ration are more inclined to heat stress than animals on higher grain rations. If given the opportunity, cows will try to eat more grain than forage, by sorting more vigorously or eating less free choice hay.
- Conduction is also responsible for accumulated heat in cattle. This happens when cattle are crowded together. For example, when cows try to get into the limited shade of a tree, and heat is “trapped” and passed by direct contact from animal to animal.

During hot days, particularly if followed by hot nights, cows accumulate heat and cannot adequately dissipate this body heat. This can cause severe heat stress and production losses. In extremes deaths from heat exhaustion have occurred during very hot humid periods.

Signs of heat stress in cows

The evidence of heat stress in cattle is often very subtle. Producers see their cows standing “quite contentedly huddled under the big oak tree at the far end of the pasture”. This may have the appearance of some idyllic country farm scene but instead has the making for a disastrous summer. Here are some of the more common signs of heat stress in cows.
- Reduced feed intake and reduced milk yield (>10%) and butterfat level (0.2 – 0.3%).
- Reduced activity but increased respiration rate (>80 breaths / minute).
- Increased body temperature (>102.5°F).
- Reduced reproductive performance.
- Monitor temperature and temperature-humidity index (<78).

Table 1. The temperature humidity index chart indicating the different effects on cattle as temperature and humidity increase.

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Interpretation of Temperature Humidity Index (THI) values:
- Normal < 74 THI,
- Alert 75 – 78 THI,
- Danger 79 – 83 THI
- Emergency > 84 THI.

Temperature Humidity Index calculation:
\[ THI = T°F - (0.55 \times (0.55 \times \text{RH} / 100)) \times (T°F - 58) \]

**Effects of heat stress on cows**

Dairy cows are markedly affected by heat stress. The most important effects are listed below.

- **Decrease in dry matter intake.** Feed intake is reduced by 10 – 15% during periods of heat stress. Early lactation and higher yielding cows are affected more quickly and severely compared to later lactation cows.
- **Decrease in milk production.** As dry matter intake drops, so does milk production. Milk production drops further if water is limiting. Cows divert water from milk production to facilitate cooling.
• **Reduced fertility / reproduction.** In a US trial the percent of inseminated cows that were confirmed pregnant dropped from 30% in winter to 10 to 15% in summer evaluated over three consecutive years. In another study conception rate declined by 5% units for every 10°F above 50°F at the time of insemination (conception rate 67% at 20°F and only 21% at 80°F). Early embryonic deaths account for significant losses in heat stressed cows.

• **Reduce rumen efficiency.** Recent research indicates that heat stressed cows have reduced rate of passage, lower rumen pH, higher rumen ammonia and change in volatile fatty acids. This affect appears to be independent of changes in dry matter intake.

• **Reduced butterfat production (%).** Butterfat declines by up to 0.3% units during summer.

There are other problems associated with increased heat in the summer, for example, a seasonal increase in bulk tank somatic cell counts. Dry cows are also affected by heat stress. Close-up dry cows are usually kept indoors in pens / groups just prior to calving. However, far off dry cows are often left outside during the summer months. Feed intake is reduced, more so since these cows are on high forage rations. There is also some evidence that birth weight is reduced in cows that have been exposed to heat stress during the dry period.

**Critical steps in controlling heat accumulation in cows**

The most important measure is to reduce heat load or increment in cows. This means dealing effectively with the three main sources of heat accumulation in cows.

• **Direct solar radiation from the sun.** Keep cows out of the sun from 8 to 9 am to at least 4 to 5 in the afternoon! This is a critical measure for controlling heat stress, especially dark coloured cows. Keep cows in the barn. If shade is provided outside, make sure there is adequate shade area, make sure the cows have fresh feed and water in the shade and watch that cows don’t end up in a wallow in the shade! Remember that high humidity exaggerates the effect of high temperature.

• **Heat of digestion.** Reformulate the ration to include less, higher quality forage but do not compromise the minimum levels for ADF (17%) and forage NDF (22%). Have forages tested to find the higher PD feeds to include or increase the level of these in the ration during summer. Feed more high quality, highly digestible forage in summer. Include fat in the ration to help maintain the energy intake when feed intake declines.

• **Heat conduction.** It is even more important not to crowd cows during hot weather. This can occur when inadequate bunk space or shade is provided or cows are crowded in the holding area.

These are critical measures to help reduce heat accumulation in cows. However, despite our best efforts and intentions, cows do still suffer some distress from heat stress during the hot summer months.
Measures to help reduce heat stress in cows

- **Increase water availability to cows.** Normal water supply recommendations are inadequate in the summer. Water intake increases by up to 50% as the THI approaches 80. Place extra water points close to where the cows spend most of the time. Make sure the water is clean, cool and fresh. Clean troughs more often in the summer.

- **Change the feeding routine.** The two most important changes are mix and feed more often and feed a greater proportion of feed at night, 60 to 70% of feed. Watch for feed heating in the bunk – clean bunks out more often.

- **Increase airflow / ventilation.** Open up the sides of the barn to maximize the natural ventilation. Install fans in the barn. The most important areas to increase ventilation are the holding area, along the inside of the feed bunk and over the stalls.

- **Ration specification changes.** Some the key changes for lactating cows: increase the ration concentration but do not compromise fibre levels, add fat to the ration, increase potassium to 1.5 – 1.7%, increase sodium to 0.45 – 0.5%, increase magnesium to 0.3 – 0.4%. This requires a careful selection of mineral sources to ensure that chloride levels are kept low. Consider a modest increase in protein but don’t over feed A fraction.

- **Ration changes.** Feed a TMR. Add water to the TMR, firstly to increase water intake and secondly to help prevent sorting by the cows.

- **Feed additives during summer.** Consider the following additives to help cows deal with the effects of heat stress. Feed Diamond V XP yeast at 45 g/head/day, Sodium Bicarbonate up to 150 g/head/day, Shur Gain RM 104 18 g/head/day.

Alleviating severe heat stress

There are some indicators of heat stress that suggest cows need help to dissipate heat. When:

- The THI increases to 78 or above,
- 8 out of 10 cows have a rectal temperature over 102.5°F,
- 10 cows have a respiration rate over 80 breaths / minute,
- Dry matter intake or daily milk is down 10%.

Any or all of these factors indicate that cows need special attention to avoid the serious consequences of hest stress. If ignored, it is possible that some animals may even die. Death losses from severe heat stress have been reported in feedlot cattle.

- **Select the most comfortable place for cows.** If cows are outside, check the temperatures and decide where it is more comfortable for cows – outside in the shade or in the barn. Don’t leave cows out in the sun.

- **Ventilation in the barn.** Make sure there is maximum natural ventilation and that the fans are running to increase airflow.

- **Indirect cooling.** Use a fine mist in the barn to cool the air. This will help reduce the heat load on the cows. Breathing cooler air will help cows cool faster. Make sure misters are effective and that they don’t inadvertently simply increase the humidity.

- **Direct cooling.** This is direct wetting of the cows. The most effective is direct wetting of the skin to enhance evaporative cooling from the body surface. Watch water does not run down to the udder and wash off the teat dip.