TechNote 21

Understand energy requirements

IN THIS TECHNOTE

In this resource "Mid lactation" covers the period from mating until February/March, with a focus on summer. A dairy cow in mid lactation requires energy to support

- maintenance,
- milk production,
- activity (walking and grazing),
- body condition score (BCS) maintenance or gain (although in some scenarios there may be minor BCS loss).

21.1 Determine body condition score (BCS) change

Compared with cows in early lactation, cows in mid lactation produce approximately 25% less milk (Figure 1) and mobilise less body tissue (Figure 2).

Figure 1. *Typical milk production change through lactation in a pasture-based system (adapted from Roche et al., 2006).*

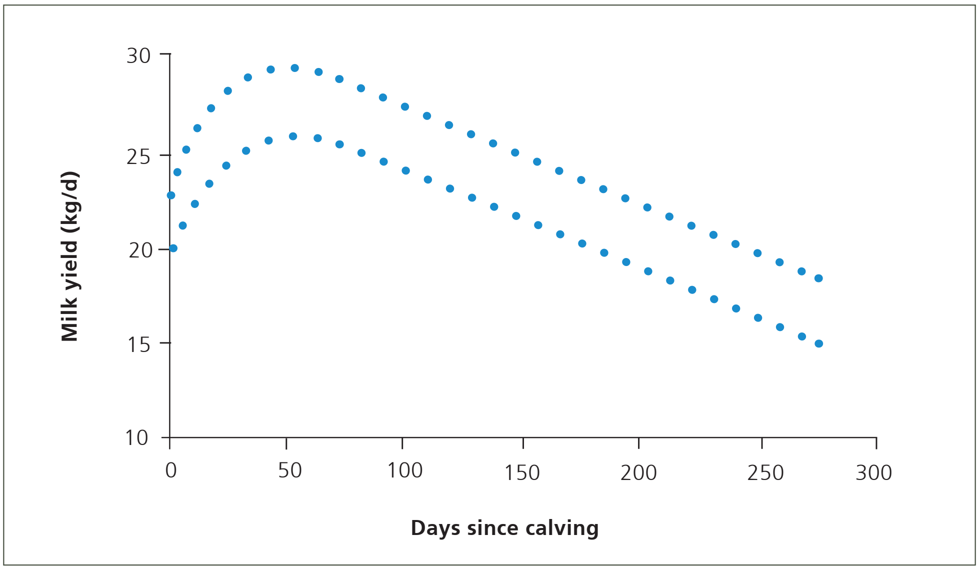
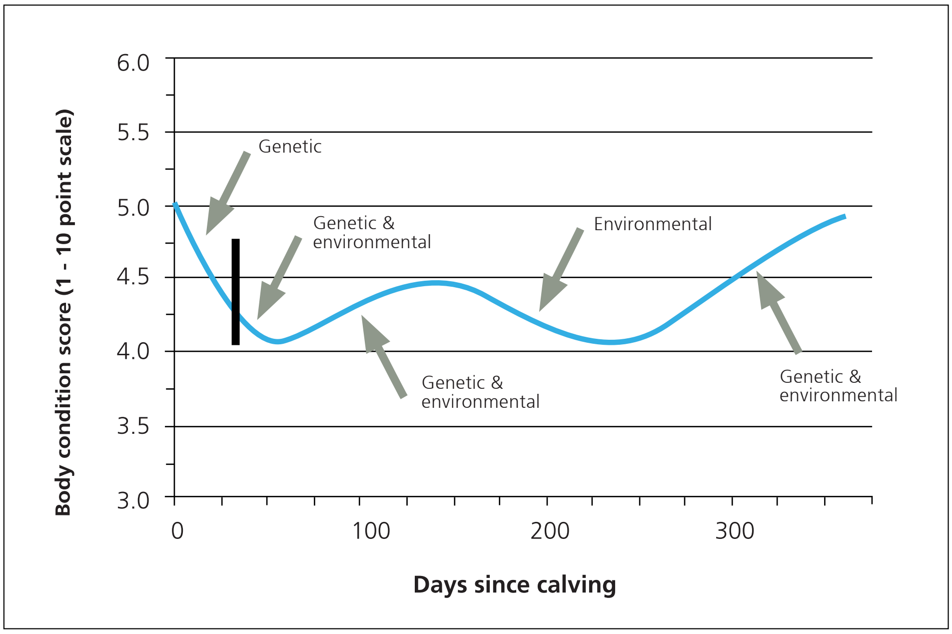


Figure 2. Average body condition score change through lactation.



During this period, energy primarily comes from the diet; however, some body condition loss can occur (Figure 2). Body condition loss during this period is primarily due to environmental factors, in particular, reduced pasture quality and/or quantity that can occur in non-irrigated, grazing systems during the mid-season, summer months. Other factors that can affect feed availability and body condition loss/gain during this period are prior pasture management, and use of supplementary feeds.

Q: Should I worry if my cows start losing BCS in mid lactation?

A: No, if cows are healthy, remain above a BCS 3.5, and have time and feed available to reach BCS targets at calving, there is no need to worry. If pasture quality and quantity drops during this period, cows can lose a small amount of BCS (< 0.5 BCS units).

21.2 Calculate energy requirements

An example of the energy required by a mid-lactation cow is presented in Table 1. More information on energy requirements is provided in TechNote 2: Tables 1 – 8. These tables, along with the DairyNZ FeedChecker or DairyNZ Facts & Figures can be used to calculate energy requirements.

For more details see TechNotes 2: Energy, mineral and vitamin requirements, and 16: Determine energy requirements.
To use the DairyNZ FeedChecker see dairynz.co.nz/feedright-feedchecker.

Q: How much does a cow eat in mid lactation?

A: A 500 kg cow producing 1.4 kg MS will be eating approximately 16 kg DM/day of an 11 ME diet (e.g. pasture plus pasture silage and/or PKE).

Table 1. *Daily requirements of a mid-lactation 500 kg LWT Kiwi Cross cow, producing 1.4 kg MS/day, maintaining BCS, walking 2 km over rolling terrain, and eating a diet averaging 11 MJ ME/kg DM.*

Requirement	MJ ME
Maintenance	59
Walking on rolling hills for 2 km (2 km x 3 MJ ME/km)	6
Milksolids (1.4 kg MS x 80 MJ ME/kg MS)	112
No LWT loss/gain	0
Total MJ ME at 11.0 ME	**177**
Total kg DM eaten (177 ÷ 11 MJ ME)	**16.1 kg DM**
Total kg DM offered (if utilisation is 95%)	**16.9 kg DM**

21.3 Determine the impact of heat stress

Heat stress (or hyperthermia) occurs when the heat load of the dairy cow (metabolic heat production) exceeds the capacity of the cow to lose heat to the surroundings. When a cow is heat stressed, her first responses are increased respiration rate, higher rectal temperature, and increased heart rate. These physical changes result in a drop in dry matter intake (DMI) and reduced milk production.

The occurrence and severity of heat stress is primarily affected by environmental, and animal factors.

21.3.1 Understand factors that affect heat stress

Environment

The key environmental factors involved in heat stress are air temperature, humidity, solar radiation, and air movement. During the warmer months of the year, (Dec to March) cows dissipate heat through radiation to the cooler air in the evenings. Therefore, high temperatures, or humidity and cloud cover, at night will increase the occurrence of heat stress. This is evident in regions such as Northland and Waikato, where day time temperatures are similar (and often lower) than those in the South Island; however, higher night time temperatures and humidity increase the risk of heat stress in these areas.

The occurrence of heat stress can be measured using the temperature humidity index (THI; Figure 3). This index combines temperature and humidity values to calculate a relative measure of "discomfort or stress".

THI =

(1.8 x Temp + 32) – ((0.55 – 0.0055 x RH) x (1.8 x Temp – 26))

Animal

Cow breed affects the point at which heat stress occurs (Table 2; Figure 3). Holstein-Friesian cows are slightly more susceptible to heat stress than Kiwi Cross cows, which in turn are more susceptible to heat stress than Jersey cows.

Table 2: *Temperature humidity index (THI) threshold at which heat stress occurs in different breeds.*

Breed	THI threshold for heat stress
Holstein-Friesian	68
Kiwi Cross	69
Jersey	75

Heat stress occurs when the average daily THI reaches 68 for Holstein Friesian cows, 69 for Kiwi Cross cows, or 75 for Jersey cows. The dashed lines on Figure 3 highlight that a THI of 69 occurs at:

- 24°C and 30 % relative humidity, or
- 23°C and 50% relative humidity, or
- 22°C and 80% relative humidity.

In addition, the colour of a cows' hide can affect the point at which heat stress occurs, with darker cows within a breed being prone to heat stress at a slightly lower THI than lighter ones.

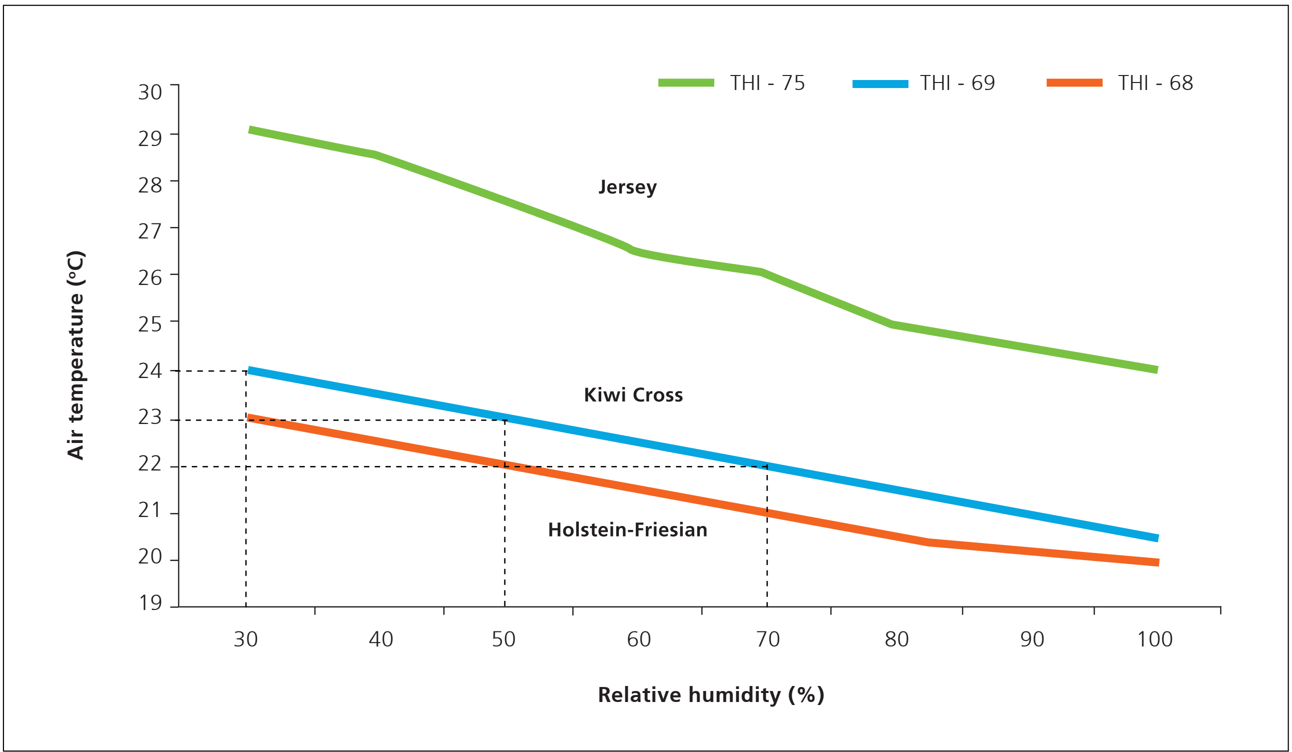
Heat stress reduces DMI and milk yield in all cows; however, the extent of reduction in milk yield is greater in mid-lactation cows compared with early- and late-lactation animals. In mid-lactation cows, the decrease in DMI only accounts for approximately 50% of the reduction in milk production, indicating heat stress responses other than feed intake (e.g. glucose and fatty acid metabolism, mammary cell function), may influence milk production in these cows.

New Zealand data indicate that both milk fat and protein percent are reduced with heat stress. A good rule of thumb is that milksolids production decreases by approximately 10 g MS/day for each unit increase in THI. This equates to a drop of 0.1 MS/day for a Kiwi Cross cow if average daily THI increases from 69 to 79.

Within each breed, cows that have higher milk production and thus a higher metabolic heat load are more sensitive to heat stress.

Milksolids production drops by 0.1 kg MS/day for a Kiwi Cross cow if temperature humidity index (THI) increases from 69 to 79.

Figure 3. *Air temperature and relative humidity for temperature humidity index (THI) thresholds for different breeds *asterix to link in with footnote please.*



*THI is calculated from air temperature (Temp) and relative humidity (RH) using the following equation: THI = (1.8 x Temp + 32) – ((0.55 – 0.0055 x RH) x (1.8 x Temp – 26))

21.3.2 Consider options to minimise and mitigate heat stress

Management and nutritional strategies will not prevent heat stress but can help alleviate the impact. These include:

- Provide adequate water. A lactating cows requires between 50 – 100 L water daily, and water requirements increase with increasing heat. Providing access to water in yards or when cows are entering/leaving the dairy can help reduce heat stress.
- Ensure summer pastures are of high quality. Feed with a high fibre content (e.g. straw, hay or poor quality silage/ pasture) increases the heat produced from fermentation in the rumen which increases the heat load on the cow. Pasture management, and in particular, meeting post-grazing residual targets in spring, will improve pasture quality in the summer months.

- If using supplementary feed, offer it to cows early in the morning or late at night when it is cooler. Remember, a cow's voluntary intake decreases with heat stress, so offering more food (pasture or supplements) will not offset the loss in milk production.
- Provide shade in paddocks, turn sprinklers on, and limit time spent standing in yards. Reduce walking if possible, especially in hot summer afternoons.
- Theoretically, high energy, low fibre supplements (e.g. barley) will generate less heat as they are digested; however, these are typically more expensive than forage based feeds (e.g. pasture silage), and generally, the extra cost of incorporating these into the system is not offset by any increase in milk production.
- Milking cows once a day (OAD) is an option to reduce the risk of heat stress, especially in regions that experience high afternoon temperatures and/or humidity.

21.4 Determine the impact of reduced milking frequency

Reducing milking frequency to OAD during mid/late lactation will reduce milk production by approximately 10 – 15%. The lower production is only partially offset by a much smaller (approximately 5%) reduction in DMI. This results in an improved energy status (immediately) and increased BCS gain after cows have been milked OAD for one to two months. More details on OAD milking, and milking 2 times in 3 days are provided in TechNotes 25 and 27. The reduced milk production and limited activity on hot summer afternoons can help alleviate heat stress in warmer regions.

For more details see TechNotes 25: Determine energy requirements, and 27: Measure and monitor body condition score.

21.5 Further reading

Bryant, J. R., N. Lopez-Villalobos, J. E. Pryce, C. W. Holmes, and D. L. Johnson. 2007. Quantifying the effect of thermal environment on production traits in three breeds of dairy cattle in New Zealand. New Zealand Journal of Agricultural Research 50: 327 – 338.

DairyNZ body condition scoring. The reference guide for New Zealand dairy farmers. www.dairynz.co.nz/publications/animal/body-condition-scoring-reference-guide/

Grala, T. M., R. R. Handley, J. R. Roche, C. G. Walker, C. V. C. Phyn, and J. K. Kay. 2015. Once-daily milking during late lactation in pasture-fed dairy cows has minor effects on feed intake, condition score gain and hepatic gene expression. Journal of Dairy Science 99: 3041 – 3055.

NRC. 2001. Nutrient requirements of dairy cattle (7th rev. ed). Washington, United States of America: National Academy Press.

Roche, J. R., D. P. Berry, and E. S. Kolver. 2006. Holstein-Friesian strain and feed effects on milk production, body weight, and body condition score profiles in grazing dairy cows. Journal of Dairy Science 89: 3532 – 3543.

Roche, J. R., N. C. Friggens, J. K. Kay, M. W. Fisher, K. J. Stafford and D. P. Berry. 2009. Invited review: Body condition score and its association with dairy cow productivity, health, and welfare. Journal of Dairy Science 92: 5769 – 5801.

Tao, S., R. M. Orellana, X. Weng, T. N. Marins, G. E. Dahl, and J. K. Bernard. 2017. Symposium review: The influences of heat stress on bovine mammary gland function. Journal of Dairy Science 101: 1 – 13.