Grain mix options to help combat heat stress

Feeding Cool Cows – Fact Sheet 4

KEY POINTS

Changing the grain type in the diet of dairy cows has limited application as a tool to mitigate the impact of heat stress.

Feeding maize grain can improve forage intake during hot weather, but the cost of grain and the duration of heat events must be considered.

Feeding supplements high in crude protein consistently improved milk production, with no negative impact on body temperature.

Feeding whole cottonseed had a negative impact on the dry matter intake of cows and should be avoided where heat events are prolonged and intense.

Introduction

The amount of feed a cow eats has a direct impact on her heat load – the more she eats the greater the heat load. However, different dietary ingredients and their inclusion rates can affect how much heat is produced per kilogram of feed dry matter (DM) eaten. The heat produced from feed is a combination of fermentation heat and metabolic heat.

Fermentation heat is heat generated in the rumen as feeds ferment. Highly fermentable feeds (that beak down quickly in the rumen) have a high fermentation heat while partially fermentable feeds have a lower fermentation heat. This is important because cows with a high rumen temperature will generally eat less than cows with a normal rumen temperature.

Metabolic heat is the heat generated by the digestion of feeds in the small intestine and when energy is used by the body of the cow.

Both fermentation heat and metabolic heat need to be considered when formulating rations for dairy cows because feeds with a low fermentation heat can have a high metabolic heat.

Feed type can also affect feed intake. Reducing the heat load on cows during hot weather is desirable to minimise the drop in feed intake and milk production. Choosing a different grain type could potentially lower the heat load experienced by cows. For example, cows offered high protein diets have been shown to eat more and produce more milk in thermoneutral conditions. This could be useful in offsetting the loss of appetite in dairy cows due to heat stress.

This factsheet describes a series of experiments conducted as part of the Dairy Feedbase program at Ellinbank SmartFarm. The effect of various types and combinations of concentrates commonly used on Australian dairy farms on dry matter intake, milk production and body temperature of cows subjected to a heat challenge was investigated.

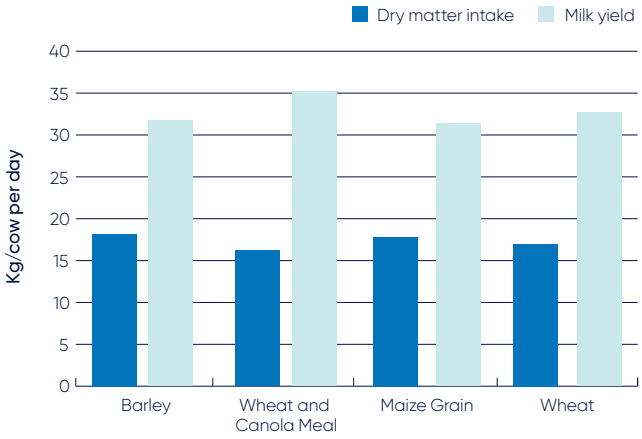
Comparing grain mixes

Each experiment consisted of a pre-heat period, a two-to-four day heat challenge generated in controlled-climate chambers, and a recovery period.

Early lactation

An experiment in early lactation (86 days in milk) compared four total mixed rations, each with the same amount of pasture silage, lucerne hay and grain, but using a different grain mix in each ration. The grain mixes used were barley, wheat & canola meal, maize grain, and wheat.

Figure 1 Average feed intake and milk yield of early lactation cows over the 5 days of measurement (pre challenge, heat challenge and recovery periods)



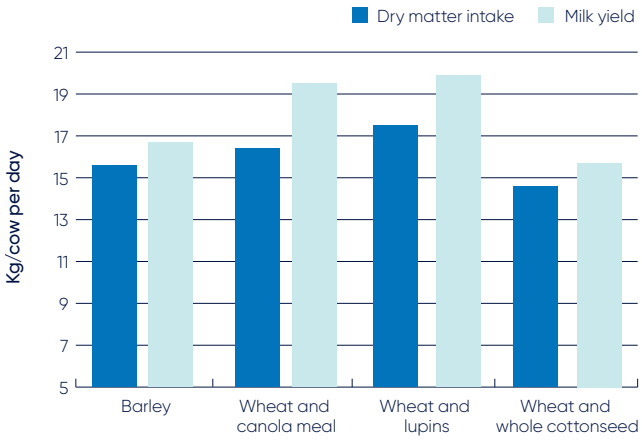
- Cows offered the diet with barley ate more than cows offered the diet with wheat and canola meal.
- Cows offered the diet with wheat and canola meal produced more milk than cows offered the diet with maize grain. However, analysis of blood metabolites indicated the cows offered wheat and canola meal may have been using body reserves during the heat challenge to support milk production.
- Cows offered the diet with barley had a lower body temperature than cows offered the diet with wheat and canola meal, and those offered the diet with maize grain.

Late lactation

Two experiments were done in late lactation.

The first of these used cows that were 231 days in milk and repeated the early lactation experiment but with a different mix of grain types. The forage (pasture silage and lucerne hay) and total grain amounts were the same in each diet. The grains tested were (1) barley, (2) wheat and canola meal, (3) wheat and lupins, and (4) wheat and whole cottonseed.

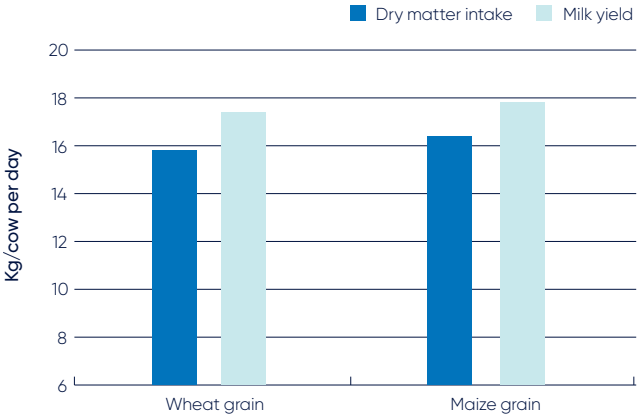
Figure 2 Average dry matter intake and milk yield across the 5 days of measurements (pre challenge, heat challenge and recovery periods)



- Cows offered the diet with whole cottonseed ate the least amount of feed across the five days and produced the least amount of milk. Most of this difference in feed intake occurred during the heat challenge. This is probably due to the high levels of polyunsaturated fatty acids present in whole cottonseed – see Feeding cool cows Factsheet Five in this series on Supplementary Fats for more information on this issue.
- The wheat and lupins mix appeared beneficial, with cows on this diet eating the most and producing the most milk.
- The high protein diets (wheat and canola meal mix and wheat and lupins mix), resulted in greater intake and milk yield than feeding barley.
- Average body temperature of all cows in the experiment was unaffected by the diets tested.

In the other late lactation experiment, cows (220 days in milk) were offered lucerne hay with either maize grain or wheat grain at the same rate. The grain was fed during milking, then the forage was offered separately.

Figure 3 Average dry matter intake and milk yield during the 4-day heat challenge period only, where the temperature humidity index (THI) was over 75



- Cows ate the same amount of concentrate regardless of the diet offered and there were no differences in intake or milk yield between maize grain and wheat cows before the heat challenge.
- Maize grain was marginally advantageous during the heat challenge, when cows fed maize grain ate more forage than cows fed wheat grain and produced slightly more milk (Figure 3).
- Over this short-term heat challenge experiment their was no clear advantage in feeding maize grain instead of wheat grain. However, in regions with prolonged and intense hot weather the greater intake of cows fed maize grain when under heat stress could be beneficial providing that feeding maize grain is economically sensible.

Economic analysis – background assumptions

As part of the Feeding Cool Cows project, farm systems economists assessed a range of scenarios to determine the net benefit of several dietary interventions to dairy cows during the summer period. Adding different grains to the diet of lactating cows, in the manner described in these experiments, only proved economical under some scenarios tested.

A future climate example for the Northern Victoria region between September to March (inclusive) was used in the economic analysis of these experiments. The period examined spanned a total of 212 days, including 91 days of heat stress conditions where the average daily temperature humidity index (THI) was above 75.

Before the experiments, threshold analysis used costs that were calculated based on the grain rates offered in the Feeding Cool Cows experiments.

Diets were assumed be fed from September to March. A five-year (July 2018 to June 2022) average milk price of $7.35/kg milk solids (MS) was used. Grain prices were as delivered to Northern Victoria. An 8% opportunity cost of variable capital was included.

Key findings from economic analysis

- In the early lactation experiment, maize grain was the most expensive grain option, costing $0.91 more per cow per day compared to feeding barley, and would therefore need to produce an extra 32 kg of MS per cow in total over the September to March period to be equally as profitable as feeding barley.
- Replacing barley with wheat cost an extra $0.32/cow per day, therefore requiring an additional 11 kg of MS per cow to be produced in total over the September to March period to be equally as profitable.
- Feeding the wheat and canola meal diet showed potential to be more profitable than feeding the barley diet over the hot weather period in both early and late lactation cows. This was because of the extra milk produced on both heat stress and non-heat stress days.
- In early lactation, neither the wheat diet nor the maize diet were clear profitable alternatives to feeding the barley diet based on the future climate scenario.
- The maize grain versus wheat comparison in late lactation indicated there may be some benefit to using maize grain in regions where there are lengthy periods of time where the THI is greater than 75, but the benefits were still marginal.
- It is important to note that results will vary between individual farms and locations with different weather profiles, and milk and feed prices.

Summary

Substituting high protein grains such as canola or lupins into a mixed ration was the superior option when developing a summer feeding strategy for dairy cows, compared to a high starch grain such as wheat or barley. Body temperature was largely unaffected by grain type.

Cows offered diets containing canola or lupins in a short-term heat challenge had better milk yield responses and dry matter intake than cows offered wheat or barley. Maize grain has some advantages but is not a clear winner. Use of maize grain over wheat as a mitigation strategy against heat stress appears to be related to stage of lactation and regional climate conditions, and any benefits are very marginal at best. Also, maize was the most expensive option tested of the starch-based grains.

Use of whole cottonseed as a higher fat and protein concentrate source is not a recommended option as it caused a significant reduction in intake and milk solids yield in the heat stress period.

Overall, when it comes to addressing the challenge of heat stress on farm, more emphasis should be placed on balanced diets and management strategies that offer physical cooling for cows (i.e. shade and sprinklers), than direct manipulation of grain mixes.

Dairy Australia Limited ABN 60 105 227 987
E enquiries@dairyaustralia.com.au
T +61 3 9694 3777
F +61 3 9694 3701
dairyaustralia.com.au

5173 | Apr 2024