Dairy cows and shade

Dr. Carel Muller
Directorate: Animal Sciences, Research & Technology Development Services, Elsenburg

Dairy cows are well adapted to cold conditions. However, these traits make them very sensitive to heat. Protecting cows against heat stress improves their welfare and production.

Introduction
At the beginning of another summer, it can only be speculated at the amount of milk (and money) that will be lost by dairy farmers because of heat stress. Heat stress occurs when the environmental temperature rises above the comfort zone of dairy cows because of solar radiation. This is aggravated by high ambient relative humidity levels. Dairy cows experience heat stress whenever the environmental temperature exceeds 24 °C. The negative effect of heat stress increases the longer this period of high temperature lasts.

Why is this?
Dairy cattle breeds in South Africa originated in Western Europe and the British Isles where climatic conditions differ considerably from that in South Africa. Although dairy cows have to some extent adapted to local conditions over the years, they still remain inherently sensitive to high summer temperatures. The reason for this is because cows have large muscle groups, a subcutaneous fat layer, a thick skin and a dense hair cover. The fermentation process of feed digestion in the rumen also produces additional heat. Moreover, the feed intake of cows is stimulated by cold while they also grow a thicker and longer hair coat during winter to limit heat loss. Research has shown that the optimum temperature range for dairy cows is 10 to 18 °C. This is a clear indication that cows prefer a cool and temperate climate.

Sensitivity to high temperatures
However, because of these anatomical and physiological characteristics, dairy cows are extremely sensitive to heat. Cows produce heat continuously due to normal metabolic and fermentation processes. Voluntary and involuntary movements also produce additional heat. This heat must be dissipated into the environment to prevent an increase in body temperature.

Between 4 and 24 °C dairy cows are within their thermal comfort zone and can get rid of excess body heat with no effect on production. When the ambient temperature rises above the upper margin of this comfort zone, cows find it increasingly difficult to dispose of body heat. Heat from the environment then presents an additional problem. When dairy cows are unable to get rid of excess body heat through the different heat loss mechanisms, body temperature increases and production is adversely affected.

Cows need shade
The necessity for shade for dairy cows is evident from the fact that during the summer the daily maximum temperature exceeds 24°C on more than 60% of all days in most parts of South Africa. Keep in mind that air temperatures generally recorded are measured in the shade which does not include the direct radiation from the sun. This

means that at an air temperature of 24 °C, ambient temperature (what the cow feels) would be much higher because of radiation heat.

A shade structure is the simplest and most cost effective way to protect dairy cows against heat stress. Due to a reduction of the direct radiation from the sun, the heat load on cows is reduced by 30 to 50%. Studies also show that dairy cows with free access to shade have a higher feed intake and produce more milk than cows that have to stand in the sun during the same period. Fewer inseminations per conception were required for cows provided with shade, resulting in a shorter calving interval.

Local research results

A study conducted at Elsenburg showed that by providing shade to Holstein-Friesian cows, their milk yield was increased by almost 6%. This study also showed that the difference between the accumulative milk yield of cows with shade and no shade increased as the summer progressed. This seems to indicate that the longer heat stress is experienced, the greater the negative effect on milk yield.

In the Elsenburg study the response to shade was, statistically speaking, relatively small when compared to studies conducted in other parts of the world. The reason for this is because environmental conditions at Elsenburg at night during summer are generally cool with average minimum temperature averaging around 14 to 15 °C. This allowed cows to recover from the day-time heat stress.

An economic analysis of the results in the trial, however, indicated that even at a 5% improvement in milk yield, the capital outlay of building a shade structure would be recovered after two summer seasons of 150 days each. This shows the investment value of a shade structure for dairy cows. Areas with higher maximum temperatures and higher relative humidity levels than at Elsenburg, the negative effect of heat stress on milk yield would be greater resulting in a faster pay-back period. It is important to note that the number of heat stress hours, i.e. hours per day that the ambient temperature is above 24 °C are more important than the daily maximum temperature. Heat stress is further aggravated by high air humidity levels.

Shade structure

When cows are kept in open camps during the day during summer, a shade structure is required. This also applies for cows that are on pasture at night and are fed supplementary feed during the day. It is best to put up the shade structure in the middle of the open camp at a convenient distance from the feed and water troughs. It should be erected with the long axis in a north-south direction to allow the sun to reach the soil surface underneath the structure for drying the soil. A space of at least 4 m^2 per cow should be provided. A smaller structure causes crowding of animals underneath the structure and will prevent cows from lying down to rest. Air flow over the animals is also reduced causing a heat buildup while the soil underneath the shade structure becomes wet and muddy. This will increase the possibility of mastitis for cows lying down.

The shade structure should be at least 3.65 m high while the length to width ratio may vary from 2:1 to more than 10:1. The structure should not be wider than 12 m as air movement under the structure is then greatly reduced.

Roofing material could be asbestos, aluminum or galvanized sheeting. Regardless of material used, the shading is improved by painting the top of the roof white and the bottom black. The white colour will reflect a portion of direct solar radiation while the black colour reduces the radiation heat from the roof onto the animals underneath the shade.

Shade netting may also be used although it is not as effective as a solid roof structure. This is because some sun is let through the netting. The maximum ambient temperature underneath a shade structure at Elsenburg was 10 °C lower than in direct sunlight whereas underneath a double-layer of 80% shade netting, the temperature difference was only 6 °C.

A shade structure over the feed trough is of little value as it is not used fully during the day. Because of the movement of the sun, the shade is sometime out of the reach of the cows. Also, if no other shade is available in an open camp, cows will converge at the feed trough causing a disruption and preventing other cows' access to the feed. Cows will sometimes lie down on the concrete apron at the feed trough, causing further feeding disruptions. This area is also usually very dirty because of manure buildup, again increasing the possibility of mastitis.

Closing

Research has shown clearly that it benefits cows to have access to a properly designed and built shade structure. This will improve the output of cows in terms of milk yield and reproduction benefiting your financial situation. Start planning now to prevent a loss in milk income the next summer.