Heat Stress Success: Managing Heifer Growth

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Introduction

Over ten years ago, studies reported that heat stress caused $2.4 billion in annual losses in the United States from decreased performance and increased mortality in production animals (St-Pierre et al., 2003). The dairy industry, in particular, is well aware of the losses it incurs from reduced cow fertility and milk production during heat stress conditions (Armstrong, 1994); however, much less is understood about the lasting impact heat stress may have on dairy heifer behavior, growth, and development. The objective of this paper is to provide a review of the implications of heat stress on dairy cattle well-being and introduce current research projects that aim to further investigate heifer well-being during hot weather.

Heat stress occurs when an animal is exposed to environmental conditions that exceed the animal's comfort zone, thus causing the animal's body to direct more energy towards maintaining body temperature. Of course, as more energy is expended for body temperature maintenance, less energy is available for milk production, growth, and health functions within the body. To classify heat stress conditions, the temperature-humidity index (THI) is commonly calculated. Its equation considers not only ambient temperature but also relative humidity. Below is one example of a THI equation:

THI = ambient temperature – [0.55 - (0.55 * relative humidity/100)] * (ambient temperature – 58.8), where ambient temperature is recorded in Fahrenheit and relative humidity is recorded as a percentage (NOAA, 1976).

The dairy industry accepted $THI \geq 72$ as the threshold for heat stress in dairy cattle for many years, until an in-depth study on dairy cattle heat stress led to a revised THI chart (Collier et al., 2012). The current THI chart guidelines classify heat stress into four main categories: $68 \leq THI < 72$; $72 \leq THI < 80$; $80 \leq THI < 90$; and $90 \leq THI$. At even the lowest heat stress category ($68 \leq THI < 72$), decreases in milk yield and fertility occur. Calculating the black globe heat index (BGHI) is also gaining popularity as a tool to classify heat stress. The primary advantage BGHI has over THI is that it takes into consideration solar radiation (Buffington et al., 1981).

Heat Stress in Cows

As expected, body temperature rises in dairy cows when they are exposed to heat stress conditions. At the lowest category of heat stress, cow body temperatures begin to rise above 101.3 °F and continue to rise as THI increases. For example, body temperatures are typically higher than 104 °F within the third heat stress category and 106 °F within the fourth category (Collier et al, 2012). It is with these changes in body temperature that dairy cows begin to

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decrease their feed intake and seek shade. Additionally, the expression of estrus decreases (Nebel et al., 1997), pregnancy rates drop, and embryo viability plummets under heat stress conditions (Ryan et al., 1993).

Heat Stress in Calves

The thermoneutral zone for dairy calves is a relatively narrow range (50 °F – 68 °F for calves < 1 month of age and 32 °F – 68 °F for calves > 1 month of age) of temperatures at which a calf does not need to expend additional energy to maintain body temperature. While several heat stress abatement strategies have been developed, one of the most fundamental strategies is to provide shade for calves during hot weather. Calves with no access to shade during heat stress conditions have lower feed efficiencies, in addition to higher epidermal temperatures and respiration rates, than calves with access to shade (Spain and Spiers, 1996). As seen in heat-stressed cows, dairy calves exposed to heat stress also decrease their feed intake. Heat stress conditions jeopardize a calf's growth and development, cause elevations in serum cortisol concentrations, and lead to increases in calf mortality rates (Neuwirth et al., 1979; Stott et al., 1976).

Current research is focused on determining how heat stress impacts dairy calf body temperatures, feeding behavior, average daily gain, feed efficiency, plasma hormone concentrations, and health. Preliminary results from Summer 2015 (Figure 1) have demonstrated the variations in individual responses to heat stress conditions.

Conclusions

On-farm considerations for heat stress abatement should be focused on cows and calves, not just cows. Heat stress impairs calf growth, welfare, and health. Given the fairly low tolerance calves have for hot weather (especially during the first month of life), and the variations in individual physiological responses to heat stress, individualized calf care is ideal. To increase our understanding of heat stress and develop improved best management practices for calves, current research is targeting heat stress studies in calves.

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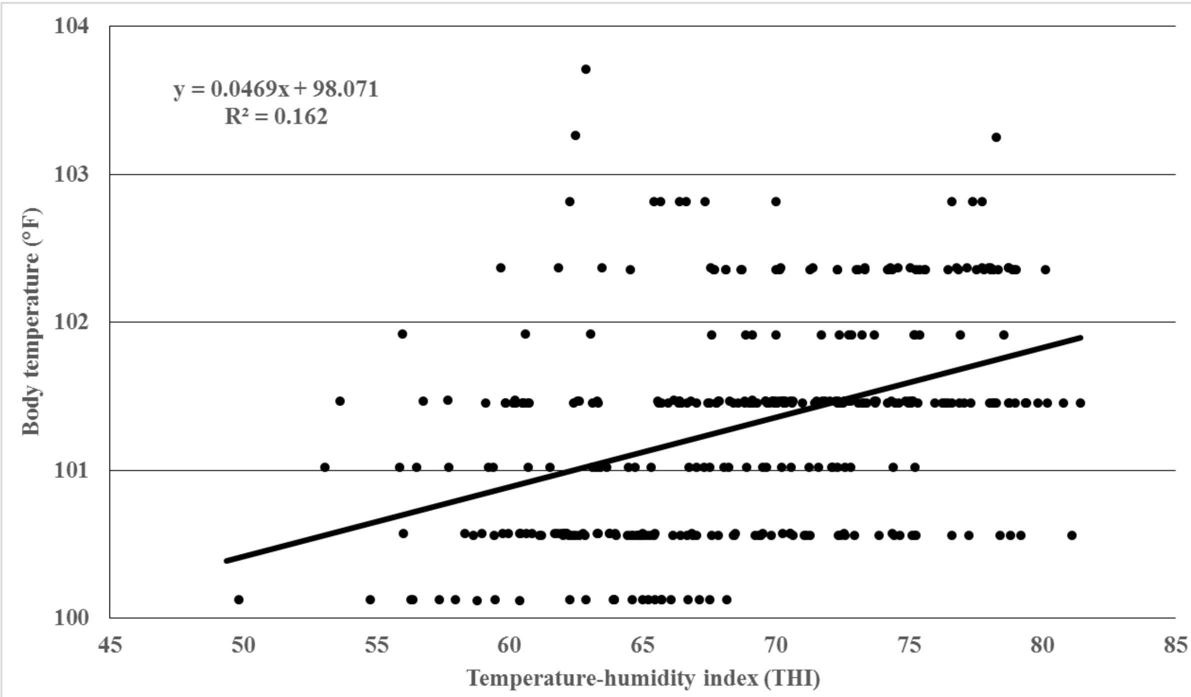
Figure 1



Preliminary data depicting the relationship between Holstein calf body temperature (n = 8 calves) and the temperature-humidity index (THI) during a Summer 2015 trial.