HEAT LOAD in Tropically Adapted Cattle

Figure 1. A Braford cow with calves under grazing conditions in Florida, U.S.

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As the harmful effects of global warming gain some traction in agriculture, forward-thinking ranchers are increasing their level of concern about how to cope with a possible warmer climate in maintaining (or increasing) their level of productivity. Heat stress brought about by a warmer climate may have resounding negative repercussions on cattle productivity, including reducing parasite tolerance, decreasing fertility and growth performance, and in an extreme situation, endangering animal breeds that once were essential to beef production. The question that is often asked is: What should we do? Perhaps a better question would be: Can anything be done to mitigate the harmful effects of heat load due to a warmer condition?

The discussion of heat load in cattle production revolves primarily around methods of identifying and attempting to mitigate it to some degree. However, summers in tropical and subtropical regions commonly result in animals continually having heat load to some degree. Often nighttime cooling is the primary form of heat dissipation, as physiological mechanisms typically cannot prevent heat load during daylight hours, most notably in areas of high humidity. From a managerial perspective, there is little that can be done to assist animals other than providing adequate space, shade and cool water to promote heat dissipation. Furthermore, the physiological mechanisms used to dissipate heat require energy, but during heat load, feed intake is reduced due to the associated metabolic heat, especially for grazing cattle. This can result in a drastic reduction in energy, thereby limiting the available energy for production. In these situations, the bad often becomes worse because many producers in these regions utilize a spring calving season. Consequently, the summer months will at least partly coincide with early- to mid-lactation cows and breeding season, typically resulting in reduced milk production and fertility to varying degrees. Persistent exposure to heat-stress environments can potentially have profound effects on conception rates, weaning weights and future performance of any retained replacement heifers.

The performance issues imposed by heat stress are the primary reasons producers in tropical and subtropical regions utilize tropically adapted breeds, *Bos indicus* or tropically adapted *Bos taurus* (e.g., Africander, Bonsmara, Tuli), to some degree. In comparison to most *B. taurus* cattle, tropically adapted animals and their crosses (Figure 1) display improved heat and parasite tolerance (tolerance, not resistance) due to anatomical differences. Heat tolerance is primarily influenced by three primary cooling methods: evaporative, non-evaporative, and respiration. Most producers recognize evaporative heat loss as the main method by which tropically adapted animals cope with the heat. This is primarily due to the noticeable (and often buyer-docked) attributes such as dewlap, navel, and ears. These characteristics result in more surface area, promoting heat dissipation via conduction and convection exchanges (e.g., wind, water). The sweat glands of tropically adapted animals also tend to be larger, more numerous, and positioned near the skin surface, enabling increased sweating rate. However, sweating does not provide an adequate cooling method when humidity is high due to resistance (lack) of evaporation, and this resistance is further amplified by the coat of *Bos taurus* animals (Figure 2). As well, sweating does not become the primary method of heat dissipation until the air and skin temperatures are similar due to lack of non-evaporative heat transfer, making non-evaporative heat transfer vital to thermoregulation.

Non-evaporative cooling occurs primarily through conductive and convective heat exchange. As noted previously, increased surface area assists in the thermal exchange between the animal and the environment. Tropically adapted cattle more easily transfer metabolic heat to the skin where it can be dissipated, promoting non-evaporative cooling. However, the hair coat of tropically adapted cattle is denser and slick, promoting the reflection of solar radiation that results in less heat absorption. Although reflectance does not dissipate heat, it does promote a reduced rate of heat uptake that assists in efficient heat dissipation. The reflectancy and absorption of solar radiation can also be affected by coat color. Heat absorption is most significant in black-coated animals, moderate in red/brown, and least in white/gray animals. Coat color is more critical for animals that are not tropically adapted due to lesser heat dissipation capacity. In tropically adapted animals, coat color has only minor effects on body temperature so long as adequate water is available to maintain hydration.

The final method of heat load dissipation is respiration. Through the process of breathing out, the core heat is removed from the respiratory tract; this can account for up to 15 percent of the heat load in animals with high heat loads. Although some heat dissipation occurs during normal breathing, most of it is removed via evaporative and non-evaporative methods. However, panting is a last-ditch attempt to control body temperature during severe heat stress events when evaporative and non-evaporative heat dissipation does not suffice. It is for this reason that breathing rate and panting scores are pivotal to identifying heat stress severity.

Bos indicus breeds (Figure 3) have different morpho-anatomical features compared to *Bos taurus* that help them to tolerate higher heat loads, making them more adapted to tropical and subtropical environments. They have longer legs to keep the body farther from the reflective surface of the soil, and looser skin and larger ears to increase the surface area to help to dissipate the body heat. They also have localized fat depots (e.g., hump) to prevent thicker fat depots under the skin that would diminish heat losses. From a survival perspective, tropically adapted animals are much better suited for environments conducive to the heat load. However, the often-unnoticed benefit of utilizing tropically adapted animals in these regions is that energetic requirements will be lower due to less energy required for thermoregulation. The capacity for tropically adapted animals to utilize more energetically efficient methods to minimize and dissipate heat load (i.e., reflect solar radiation and convective cooling) enables digestive and metabolic functions to be altered to a lesser degree. This allows tropically adapted animals to stay on feed, reducing the need to utilize fat reserves for energy. Since cow maintenance represents the highest cost in cow-calf enterprises, the utilization of tropically adapted animals can likely assist in improving economic efficiency by reducing the cost per pound weaned in environments that are conducive to tropical breeds. However, national and regional market trends will be a significant determinant of long-term economic sustainability for a specific area due to price docking of *B. indicus*.

Figure 2. A diverse group of *Bos Taurus* in confinement in Queensland, Australia.

Figure 3. A diverse group of *Bos indicus* bulls under grazing conditions in Nairobi, Kenya.