SELECT SIRES

HEAT STRESS MANAGEMENT

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Heat stress results in decreased feed intake and performance.

INTRODUCTION

It's no secret that many areas of the world (especially the tropical, subtropical and arid zones) suffer significant economic losses each year due to heat stressed cattle. These losses are manifested directly as losses in milk production and weight gain or indirectly as a result of decreased reproductive performance. This decrease in reproductive performance is usually expressed as an increase in services/conception, increased average days open and decreased conception rates.

In order to better understand how to manage heat stressed cattle, we first need to understand what causes heat stress and what the cow is doing herself (physiologically and metabolically) to compensate for the increased heat load. By understanding how and why the cow has decreased production and reproduction, we can make better management decisions to get her back on track.

WHAT IS HEAT STRESS?

Body Heat Production

External environmental temperatures only partially account for the total heat load on an animal. Heat produced internally by rumen fermentation and nutrient metabolism also contribute to the total. The amount of heat generated by these processes will vary greatly depending on the type, quantity and quality of feed consumed. In general, rations high in roughage or fiber will result in higher amounts of internal heat production than concentrates.

Physical activity or exercise increases the metabolic rate of skeletal muscles and thus increases internal heat production. Therefore, a natural response to heat stress is to decrease physical activities. However, in extreme situations, animals may increase physical activity by seeking shade or wind in an effort to keep cool. This increase in activity may actually increase the total heat load on the animal.

The ability of an animal to adapt to high environmental temperatures is negatively affected by high internal metabolic heat associated with milk production. Thus, lactating cows are less heat tolerant than nonlactating cows. This presents a particularly serious problem for the dairy industry of the southern U.S. where conception rates often drop to 10-15% during the summer months.

Environmental Heat Gain

The two major sources of environmental heat are solar radiation and high ambient temperatures. Together, these factors can result in severe thermal stress.

As the environmental temperature rises, the gradient between the cow's body temperature and the environment is reduced. This limits the cow's ability to dissipate body heat. Although little can be done to alter air temperatures in the environment, reducing the effects of solar radiation by providing animals with access to shade is imperative.

Heat Loss

Most mammals try to maintain a relatively constant body temperature despite wide fluctuations in the environmental temperature. Maintaining body temperatures within a fairly narrow range is essential to biochemical reactions and physiological processes of normal metabolism. Therefore, it is vitally important for animals to dissipate excess body heat during periods of stress.

There are four basic methods by which cows can dissipate body heat: evaporation, conduction, convection, and radiation. The latter three are termed nonevaporative cooling and require a thermal gradient between the cow's body temperature and the surrounding environment to be effective. When such a situation exists, cows can cool themselves by transferring body heat to the surrounding environment. However, as summer temperatures narrow the range between body temperature and the environment, these methods become less effective and the cow must resort to evaporation as a means of cooling.

Nonevaporative Cooling

Conduction is based on the principle that heat will flow from warm objects to cooler objects. This requires physical contact with surrounding objects, a temperature gradient and thermal conductivity of the opposing surface. A good example of cows cooling themselves by conduction is wading into a cool pond or lying on a concrete floor.

Convection cooling occurs as heat is transferred to the air once it comes in contact with the skin. Dissipation of heat by this method is affected by body surface area, body surface temperature, air temperature and especially air movement. A cool breeze greatly enhances the cow's ability to regulate heat by convection.

Cows will cool themselves by any means available.

Radiation is influenced by the same factors as conduction and convection, but also by the ability of the animal skin to absorb and emit heat.

Nonevaporative cooling is the principle method of heat loss when ambient temperatures are below 70°F. The effectiveness of all three of the nonevaporative cooling methods, however, declines rapidly as the ambient temperatures rise. We must also keep in mind that extremely high ambient temperatures can cause this process to work in reverse. Thus, animals could absorb heat from nonevaporative cooling of surrounding objects such as buildings, dirt, air, or other cows.

Evaporative Cooling

As ambient temperatures rise and nonevaporative methods become less effective, cows begin to use evaporative cooling to dissipate body heat. Evaporative cooling occurs as cows evaporate water (sweat) from the skin and respiratory tract. In general, whenever ambient temperatures exceed 70°F, evaporation becomes the principle method of heat loss by cattle.

High humidity is a major obstacle affecting evaporative cooling. Humid air is more saturated with water and impedes the transfer of water and heat to the surrounding environment. Increasing air movement may help to overcome the negative affects of high humidity on evaporation.

Maintenance of normal body temperature requires an equilibrium between heat gain and heat loss. The cow has incredible physiological capabilities of regulating body temperature, however, high temperatures, high humidity, solar radiation and production demands can often overload her thermoregulatory capabilities. This results in the phenomenon commonly known as "heat stress."

MANAGING HEAT STRESS

Basics

Obviously, the most basic management practice for handling cows in heat stress environments is to provide protection from direct sunlight. Cows should have free access to shaded areas during hot weather, be it from a grove of trees, shade screens, sheds or a pole barn. Shade, whether natural or artificial, can reduce the heat load on animals by 30%. This may translate into increased dry matter intake and reduce the effects of heat stress on production. Cows which are allowed access to shaded areas have been observed to produce 10.7% more milk and had 19.1% higher conception rates than non-shaded animals.

Provide adequate shade during periods of heat stress.

Shade is especially important at the feedbunk and watering troughs. Since heat stress reduces feed intake, cows should not be baking in the sun while they try to eat. Also, placing feed and water close to shade structures will reduce the amount of physical activity required to move between these areas and thus, decrease the potential heat load on the animal.

Other practices which reduce daily physical activity will also help reduce the potential for heat stress. Design walkways and loafing areas for proper drainage so cows will not have to trudge through mud. Providing effective fly control will also help.

Feedbunk shade is important .

Make sure cows have free access to an ample supply of cold water during periods of thermal stress. Although water is essential throughout the year, supplying cold water during warm weather will help cool cows. Thus, cows would be more likely to maintain high levels of feed intake and production.

Crowding should also be avoided. Cows cannot effectively dissipate their own body heat when they are cramped and exposed to the additional body heat of surrounding cows. Reduce the number of cows per milking group so as to minimize the amount of time spent in hot, crowded allies and holding pens. This may require temporary fencing of additional space or moving a group of dry cows to a new location. The effectiveness of a cool circulating breeze is also diminished in overcrowding situations.

Nutrition

Since cows will often decrease feed intake by as much as

25% in heat stress situations, they need to get more energy from the feed they do consume. Therefore, rations fed during periods of heat stress should contain a higher percentage of protein and energy. Also, much of the internal heat produced by animals is a result of digestion of roughage and fiber. Thus, reducing fiber intake will help to relieve the heat load on animals. Both of these strategies may be met by increasing the percentage of concentrates in the diet. Lactating dairy

Avoid overcrowding.

cows may also require additional sodium and potassium in their diet due to the considerable amounts lost by perspiration. Any alterations or modifications to the diet, however, should be done under the guidance and approval of a qualified nutritional consultant and/or veterinarian to avoid compounding the problem with acidosis or an unbalanced ration.

Estrus Synchronization

The inter-estrus period has not been shown to be significantly affected by periods of high environmental temperature. However, estrus periods of cows experiencing heat stress in the southeast U.S. have been observed to be shorter in duration and lower in intensity than those of cows in more temperate environments. Heat stressed cows will be reluctant to spend their energy on mounting and other physical activities which would increase the total heat load. Thus, cows exposed to high environmental temperatures will cycle fairly normally (every 18-24 days); but, due to the shorter duration of the estrus period and the decrease in physical activity (i.e. - mounting, walking fences, etc.) it will be much harder to catch these animals in heat.

Heat-stressed cattle appear to respond extremely well to prostaglandin injections. Therefore, estrus synchronization programs could be effectively implemented with other environmental management systems. Groups of cows could be synchronized during hot weather to facilitate heat detection efficiency and managed intensively to maximize pregnancy rates. Synchronization programs could also be used in the spring to get cows bred earlier in order to avoid breeding during the warm summer months.

Facilities

Give special attention to building design and location in areas where heat stress is often a problem. Structures are too often designed and constructed to keep cows and workers warm during the winter when, in fact, more attention should be given to keeping the environment cool during the summer. In Florida and many of the gulf states, cold temperatures are only a problem for one or two months of the year. Therefore, it would be impractical to design a facility to conserve heat which would only be functionally efficient during two months of the year.

Design buildings and shade structures to maximize air flow. Open sides or windows will allow heat to escape and greatly reduce interior temperatures. Canvas curtains can also be used with these open structures during the winter months to block wind and aid in heat retention.

Design facilities for maximum air flow.

Leave the center eave open in barns to allow rising body heat to escape while aiding in the circulation of cooler air underneath. A roof with 4:12 or 3:12 slope will facilitate the flow of warm air up and out through the center eave. Roof material of a bright color and made of a highly reflective material works best. This reduces the amount of heat absorbed by the structure from solar radiation.

Fans may also be used with these structures to aid in air flow and circulation. Fans are especially important in crowded holding pens where cows may stand for long periods prior to milking. Give special attention to fan placement. Locate fans such that air is moved in a uniform direction through the structure and out from underneath. Stirring stagnant air without encouraging the addition of fresh air is of limited value. Placing fans to blow with the direction of the prevailing winds, rather than against, will also aid circulation.

Open up solid walls or fences in existing structures to encourage natural air flow. Also, don't stack hay, park equipment or place other physical barriers in areas that may restrict air flow to your cows.

Leave eaves open to allow heat to escape.

Evaporative Cooling Systems

Proper fan placement will encourage air circulation.

Evaporative cooling systems use a combination of fans and misters to add moisture to the air. This cools the air and aids in heat exchange between the cow and the environment. These types of systems are not as efficient in humid climates as they are in more arid regions. This is directly related to relative humidity and the ability of the air to absorb additional water. In tropic and subtropic areas, such as Florida, high relative humidity throughout the year limit the application of this type of cooling system. Researchers in Arizona, however, have successfully reduced air temperatures by 10 to 12°C using this equipment.

Recent studies in Arizona and Israel have used upper body sprinklers in combination with large fans to aid in evaporation of water from the body surface. The spray nozzles, however, must emit water with sufficient pressure to penetrate the hair coat. Water is retained for evaporation and would not be shed by the hair surface. These evaporation systems have the potential to effectively reduce body surface temperature and aid in the removal of excess body heat.

Misters and fans can reduce air temperature.

Genetic Selection

The amount of heat absorbed by cows is directly related to coat color. Black cows may absorb as much as twice the heat from solar radiation as white cows.

However, skin pigmentation is also an important mechanism for protection from radiation damage. Light skinned cows may be more susceptible to sunburn, skin cancer or other related diseases. No studies to date have been done to reliably compare black and white cows for responses in lactation and reproductive performance. Nevertheless, genetic selection for coat color may be of value to provide some heat tolerance.

Fans and misters can be affective in crowded holding pens.

Use A.I. During Heat Stress

Bulls are also very susceptible to heat stress. Some bulls exposed to even short periods of thermal stress have significant reductions in semen quality that may last for more than a month. Extended periods of high environmental temperatures may also reduce the quantity of sperm in each ejaculate as well as the bulls sex drive or libido. Bulls at Select Sires are housed in air conditioning or well ventilated barns to minimize effects of heat stress. The use of A.I. during heat stress periods can expose cattle to better quality semen than a bull running with the herd can provide.

SUMMARY

Minimizing stress is essential to achieving and maintaining maximum productivity and profitability in any cattle operation (beef or dairy). Every summer, the stress associated with increased environmental temperatures results in decreased performance in herds throughout the United States. Although we cannot change the weather, we can alter our management practices in order to minimize the effects of hot weather on our animals. Management practices and/or technical procedures should be carefully evaluated, however, prior to adoption. Be careful not to over-invest your capitol in equipment, facilities or procedures that will be of limited benefit. Most of the answers to heat stress reside in fairly simple and inexpensive modifications that return profit and performance to the summer season.