Management of Heat Stress in Dairy Cattle

Tripti Kumari^{1*}, S. Pan², Champak Bhakat³ and R. K. Choudhary⁴

¹Ph.D Scholar, ³Principal Scientist, Department of Livestock Production and Management, Eastern Regional Station, National Dairy Research Institute, Kalyani- 741235 (W.B)

²Professor, Department of Livestock Production and Management, ⁴M.V.Sc Scholar, Department of Veterinary Pathology, West Bengal University of Animal and Fishery Sciences, Kolkata- 700037

****Corresponding Author: triptilpm@gmail.com**

Heat stress is a natural phenomenon that affects dairy cows severely during the summer months. Heat and humidity during the summer months combine to make very uncomfortable environment for dairy cows. The thermo-neutral zone of dairy cows ranges from just above zero to 22°C, above this critical temperature (combined with humidity) cows begin to alter their basal metabolism and metabolic rate which negatively impacts a variety of dairy parameters including milk yield and reproduction and therefore is a significant financial burden. But heat stress can be reduced by providing proper management at farm.

Management of heat stress

Three types of management can be done to reduce the heat stress in dairy cattle-

1. General management :- It can be done by
 - (A) Cooling method by reducing ambient air temperature
 - (B) Increasing cow's natural heat loss mechanism and
 - (C) Maximizing water availability .
2. Housing management :- It can be done by providing typical shade structure.
3. Nutritional /Feeding management: - It can be done by providing proper nutrients in appropriate amount to the heat stressed animal.

1. General Management- (A) Cooling method

It can be done by reducing ambient air temperature through Misters, High Pressure Foggers, Evaporative Cooling Pads and Fans.

Misters

- ✓ Misters under the shade in the loafing area should be used in conjunction with fans, at 8 to 9 feet above grade and oriented down at about 30 degrees, so that the water is blown on to the

cows.

- ✓ The objective of misters is not to cool the air, but to
- ✓ put water on the cows where its evaporation provides the cooling.
- ✓ Bunk line misters should be oriented over the cows, and water volumes must be low enough to prevent slick conditions at the bunks. Bunk line misters are seldom required at night. Cattle in freelot can be provided this. There should be roof peak opening and sides of the wall opened to provide free flow of air through covered area.
- ❖ It is being practiced in the foreign countries.

High Pressure Foggers

- ✓ It is based on spraying the water as small droplets (in the fog range, 2-60 μm in diameter) in order to increase the water surface in contact with the air. Fog droplets can be generated by several methods, but using the high pressure nozzles is the most economic. The efficiency of this system can be increased by full or partial control of the air movement and circulation through the building.
- ✓ It is technically difficult, because of fine nozzles, per 1°C cooling, relative humidity increases by 5%.

Schematic view of the prepared system (a) Forced ventilation and (b) Natural ventilation

Evaporative cooling pad and fan

- ✓ It is based on forcing outside air into the building through a wet pad, which humidifies and cools it only at the entrance, where the wet pad is situated.
- *In Indian condition gunny bag is used as pad.

Cooling livestock buildings by Pad and Fan Evaporative Cooling System (Pad Cooling)

(B) Enhancing the cow's natural mechanism of heat loss

- I. Sprinkler and Fan Cooling Systems (Direct Evaporative Cooling)
- II. Wallowing
- III. Sprayers in Parlour exit lanes

I. Sprinkler and Fan Cooling Systems (Direct Evaporative Cooling)

(a) Sprinkler Cooling Systems

- ✓ Sprinkling (not misting) the cow with water to fully wet her body and using fans to evaporate the water cools the cow and encourages greater feed intake and milk production.
- ✓ Research shows an 11 % increase in milk yield when cows were cooled with fans and sprinklers compared with shading alone.
- ✓ Sprinklers and fans are usually placed next to the feed bunk so that the feeding area is the coolest place on the farm, helping to encourage greater feed intake.

(b) Fan Cooling Systems

- ✓ The use of fans, particularly in areas of poor ventilation, is generally considered beneficial in preventing cows from becoming hot.
- ✓ Supporting ventilation (a) required at air speeds <1m/s
(b) highest cooling effect at 2.5 m/s air speed; harmless up to 5m/s.
- ✓ One particularly critical housing area is the crowd pen prior e milking parlor. Heat stress can occur here at relatively low environmental temperatures due to crowding. This area should have sufficient fans and misters to assure an air turnover of up to 1000 cubic feet per minute per cow.

II. Wallowing

- ✓ Wallowing is the cheapest and least laborious device to beat the heat in summer. Buffaloes are made to wallow in clusters in ponds, rivers, tanks or other water bodies for hours together.
- ✓ Wallowing is an important route of heat loss in view of the labile body temperature which enables the animal to store body temperature.
- ✓ During wallowing rectal temperature decreases gradually but falls abruptly after the buffaloes leave the water. Wallowing becomes more effective if buffaloes remain in shade after getting out of water. This device is more effective than showering, but

wallowing in dirty stagnant water exposes the animal to bacterial and parasitic invasions. Wallowing is more economical due to limited recurring expenditure and increase in milk production in comparison to shower.

III. Sprayers in Parlour exit lanes

- ✓ Cows should have access to fresh water at the parlor exit even if water is available in the pens. In addition, cow activated showers as the cows walk back to their pens, have been effective at reducing heat stress
- ❖ Only deliver enough water to wet the cow.

(C) Maximizing water availability

- ✓ It should be available as fresh and clean. Cool water should be provided during the summer months.
- ✓ Drinking water three-four times a day is a need in summer months in general farm practice.

2. HOUSING MANAGEMENT

Typical shade structure-

- The effect of shades on performance of dairy cows in dry lots demonstrate increased DMI and milk production from cows provided with shades in the loafing area.
- Cows provided with shades in the loafing area are less hot (i.e., their body temperatures are lower) and that they feel less hot (i.e., their respiration rate is lower).
- Shaded cows also produced more milk and had fewer services per conception than unshaded cows.

(i) Natural shade

(ii) Artificial shade - (a) Portable Shade (b) Permanent Shade Struc

(i) Natural shade

- ✓ Trees are an excellent source of shade and if given the choice cows will generally seek the protection of trees rather than man-made structures. They are not only effective blockers of solar radiation but the evaporation of moisture from leaf surfaces cools the surrounding air without appreciably interfering with air circulation.

(ii) Artificial Shade

(a) Portable shades

- These shades should be oriented in a North/South direction, provide about 40 to 45 square feet of shade per cow, and be about 12 to 13 feet high. There should be a raised dirt mound under the shades to prevent accumulation of moisture, and it should be groomed regularly.

- Mesh shadecloth is lightweight, available in numerous sizes can be used in portable installations.
- Most studies on shade have used solid roof structures although shade cloths, such as woven polypropylene, provide about 80 to 85% as much shading and are considerably less expensive.

Portable sheds

(b) Permanent Shade Structures

- 1) Shade structures of 40 feet or less require a minimum eave height of 12 feet. Structures wider than 40 feet should have eave heights of 16 feet.
- 2) There should be at least 50 feet of clearance between adjacent buildings or other obstructions.
- 3) Gable roofs should have at least a 4:12 slope (6:12 is acceptable but difficult to work on) and a continuous open ridge. Ridge caps if desired should have a minimum of 1 foot of clearance between it and the roof peak.
- 4) Ridge openings should be a minimum of 1 foot wide plus 2 inches for each 10 feet of structure width over 20 feet.
- 5) Painting metal roofs white and adding insulation directly beneath the roofing will reflect and insulate from effects of solar radiation and will reduce thermal radiation on cows.

Permanent Shed Structures

3. Nutritional /Feeding management

It includes:

- Energy is a critical nutrient during heat stress. The diet must be made more energy dense to provide sufficient energy to maintain milk yield.
- Increasing the energy in the diet can be achieved by increasing concentrates (grains) and decreasing forages in the diet. However increasing concentrates to greater than 55 to 60% of the diet dry matter is risky and can result in depressed milk fat content, acidosis, off-feed, laminitis, and reduced efficiency of nutrient use.
- Added dietary fat is an excellent way to increase energy content of the diet, especially during summer when feed intake is depressed.
- Fat is high in energy (about 2.25 times as much as carbohydrate), does not add starch to the diet (minimizing rumen acidosis), and may reduce heat load in summer. Added dietary fat often boosts milk fat.
- Minerals play a very important role in reducing heat stress.
- Care should be taken to supplement extra minerals

Nutrients	Change and dietary concentration (DM basis)
Energy	Increase to compensate for reduced DMI. A .80 Mcal NE _L per pound is probably the maximum that can be obtained with adequate fiber levels.
Fat	Added amount should not exceed 4%. Strategy suggested is add 1 lb from animal, 1 lb from vegetable and a final 1 lb from a rumen inert source.
Protein	Meet overall CP requirement by adjusting concentration as needed. Use a combination of rumen degradable and undegradable sources achieving a rumen undegradable level of 36 to 40% of CP.
Sodium	Increase using buffers to .45 to .55.
Potassium	Increase to 1.2% or more. High quality alfalfa is a good source.

Feeding programs of dairy cattle

Salt	Feed 3 to 4 ounces per cow per day.
Chlorine	Minimum - .25%, maximum - .35%.
DCAB (Dietary cation-anion balance)	$\text{Na} + \text{K} - \text{Cl} \sim 35 \text{ to } 45 \text{ meq/100g DM}$ $(\text{Na} + \text{K}) - (\text{Cl} + \text{S}) \sim 25 \text{ to } 35 \text{ meq/100g DM}$
Magnesium	Increase to between .3 and .35%.
Niacin	6 g per cow per day
<i>Aspergillus oryzae</i>	3 g per cow per day

CONCLUSION

Heat stress is one of the most important factor to be considered in dairy cattle during summer months. It is one of the leading causes of decreased production and fertility in the animals during hot environment. It severely affects the animals which signifies really a challenge to livestock sector. However some heat stress is unavoidable, but effects can be minimized if certain management practices are followed regarding cooling of animals and temperature inside the shed, housing and feeding. Hence by the implementation of appropriate strategies with proper management at farm, the negative effect due to heat stress in dairy cattle can be alleviated.