Climate Change

By Dan McFarland

Heat stress abatement techniques for dairy cattle

Productive dairy cows may experience heat stress when the Temperature Humidity Index (THI) is 68 or greater. In more humid climates this can occur at temperatures as low as 72°F. Heat stress can be reduced by slowing heat gain to the cow, and improving heat transfer rate from the cow. Basic heat stress abatement techniques include: Shade, Air and Water (SAW).

Heat stress occurs when heat gain is greater than loss. Balancing gain and loss over a 24 hour period is the goal.

Shade: Protecting cows from direct solar radiation helps lower their body temperature and respiration rate. Shade can be provided by trees, buildings or shade structures. Roofs and shade structures should be at least 12 feet high and oriented properly. Buildings and covered outside feeding areas are typically placed East-West to minimize sunlight intrusion throughout the day. Placing pasture or dry lot shade structures North-South allows shade to move from West to East, helping to keep the resting area drier.

Air Exchange: An air exchange every minute or less during the summer months is essential to remove moisture, gases, heat and other pollutants from the animal space. Without a proper air exchange other heat stress abatement techniques will not work effectively.

Mechanically ventilated dairy buildings use exhaust fans and properly sized and placed inlets throughout the animal space. Tunnel ventilation can provide a rapid air exchange in tie stall barns.

Naturally ventilated buildings depend primarily on wind speed and direction to drive the air exchange. Buildings with high side and end walls fully open to resting cow level create a preferred pavilion-like design during the summer.

When the warm weather exchange rate in naturally ventilated buildings is challenged by topography, up-wind obstacles or building limitations, well-designed tunnel or cross ventilation systems can be used to provide the necessary air exchange.

Air circulation: Turbulent air movement around cows increases convective heat transfer, enhances evaporation and minimizes hot spots. Air speeds of 3.5 to 5 miles per hour (mph) are preferred in resting, feeding and holding areas.

36 to 52 inch diameter axial circulation fans can provide excellent animal space air movement. To be effective, fans placed in-line must be no further than 10 times their diameter apart. For side-by-side applications, place fans two to three times their diameter apart.

Large high volume, low speed (HVLS) fans can also provide air movement at cow level, but they must be placed over the animals, and usually no more than twice their diameter apart.

Drinking Water: Increased respiration and urination during hot weather may increase drinking water intake by 20 percent or more. Watering stations need to be located conveniently, allow multiple cows access and keep up with water demand.

Evaporative Cooling: Evaporative cooling uses water to increase heat transfer from cows. The evaporation of a pound (or pint) of water requires about 1,000 British thermal units (Btu) of energy, approximately the heat produced by 1,000 four inch wooden matches.

Hissong spray cooling.

Direct evaporative cooling (DEC) systems intermittently apply and evaporate water from the cow's skin, drawing heat directly from her body. Indirect evaporative cooling (IEC) lowers the temperature of air surrounding the cow, increasing her heat transfer rate.

Spray cooling systems are low pressure DEC systems installed in feeding and holding areas that use a five to 15 minute wet-dry cycle. Spray nozzles emit a coarse droplet that penetrates the cow's hair coat soaking her skin for one to three minutes. Fans provide air movement for the remainder of the cycle to speed evaporation and draw heat away from her body. Studies show the respiration rate of a heat stressed cow decreases with the first wet-dry cycle. DEC seems to be the most effective evaporative cooling method for cows in more humid climates. However, it can require a significant water supply and good drainage.

Indirect evaporative cooling (IEC) uses heat in the air to evaporate water, lowering the dry bulb air temperature. The heat transfer rate increases when the difference in temperature between the cow's body and surrounding air is greater. Heat transfer from within the body also improves as cows inhale cooler air.

Fogging and misting are examples of IEC systems that use pressure to force water through nozzles emitting very small droplets. High pressure systems emit finer droplets that have a better chance of evaporating before settling on the cow's hair coat, resting surface and floor. Nozzles for lower pressure systems emit larger droplets, and are typically installed on circulation fans, so air movement can aid in evaporation. Pressurized IEC systems are popular in arid climates where the droplets are more likely to evaporate suspended in the air. These systems are prone to drift in naturally ventilated buildings.

Evaporative pads are another method of IEC. Thick, water-soaked corrugated pads are installed at inlet opening(s) used with tunnel and cross ventilation systems. Outside air drawn through the pad evaporates as much moisture as the air conditions allow, lowering the dry bulb temperature. All air drawn through inlet is cooled and can only pick up as much moisture as the air conditions allow.

Since evaporative cooling systems incorporate adding water to the animal space air, ventilation systems that provide a good air exchange to remove moisture-laden air and circulation fans to enhance evaporation, are essential.

The techniques for combating dairy cow heat stress currently available include shade, an adequate air exchange, good air movement, drinking water and evaporative cooling. Used properly, these tools can help balance the daily heat gain and loss of dairy cows, minimizing heat stress effects, and improving cow health, production and well-being during the summer season. ❐

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Is it weather or is it climate?

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Do you know what the difference between weather and climate is? Both of them rely on observations of temperature, pressure, sunlight, clouds, rain and wind to describe the conditions of the atmosphere near the surface of the earth. The main difference between the two is the time scale over which the conditions are described.

Weather is generally a snapshot of the atmosphere at a single time or over a few days. You can think of it as the atmosphere's day-to-day "mood," with all its short-term variability and excitement. Weather tends to look forward in time to conditions over the next few days, although it can also be used to describe specific events which have happened in the past.

Climate usually refers to conditions spanning months, years, and even centuries. Many people think of climate as "average weather" and it is often described that way, but it is more accurate to think of it as the atmosphere's "personality," an overall state on which the short-term variations of weather or "mood" are superimposed.

Often, because of the use of statistics, climatologists look backward in time to make sense of past conditions, but increasingly they are also now starting to use long-term climate models to predict what the climate might be like in the future. These models are similar to weather forecasting models in their use of physical equations of motion to make the predictions, but different in that the models are designed to get the long-term climate right rather than any individual storm, which is so important for weather forecasting of a hurricane or blizzard.

Computer models allow us to understand how individual contributions from climate factors can affect temperature, rainfall and other atmospheric quantities. These factors include sunlight, cloud cover and ocean circulations, among many others. Some of these vary naturally on a variety of time scales (from seasons to millennia, as the continents change position, for example). Others change due to human contributions to air quality and pollution, changes in land use, and the composition of the atmosphere, including greenhouse gases. These changes happen on a variety of time and spatial scales. Natural and human-induced climate changes often happen at the same time but can have different impacts depending on how fast and how extensively the changes are occurring. ❐