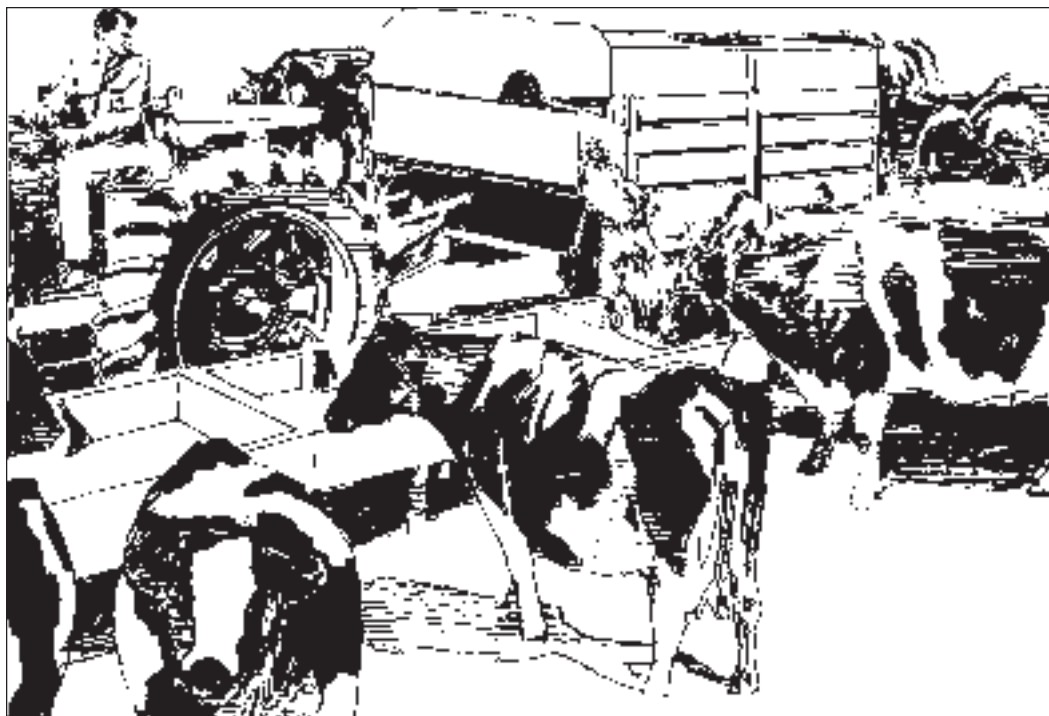


Is Your Dairy Management Program

Ready for the Summer Heat?

Sandy Stokes*



Generally, the higher producing the cow, the higher the body temperature produced from her digestion and metabolism.

High summer temperatures make dairying a challenge. Dairy cows suffer heat stress when their bodies build up more heat than they can release. External heat accumulates from solar radiation, high ambient air temperature, and high relative humidity. Heat produced by the cow's own body makes the situation worse. Generally, the higher producing the cow, the higher the body temperature produced from her digestion and metabolism.

Figure 1 illustrates the critical heat load zones for dairy cattle. The Temperature-Humidity Index

is a single number reflecting the combined effects of air temperature and relative humidity. The THI is a discomfort statistic and can be calculated as: $(0.8 \times \text{dry-bulb air temperature}) + (\text{relative humidity} \times (\text{air temperature} - 14.4)) + 46.4$. Indexes above 72 are usually associated with heat stress in cattle.

Cows pant and sweat in response to heat stress; if these do not lower the heat load, the cow's body temperature will rise. Increased body temperature results in a higher maintenance requirement in an attempt to dissipate the heat load. Panting has been shown to increase this requirement as much as 25 percent. However, heat stress causes cows to eat less at the

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Figure 1. The Temperature-Humidity Index (THI)—critical temperature zones for dairy cattle.

Deg F	Deg C	Relative Humidity																																										
		0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100																						
72	22.2																					72	72																					
73	22.8																						72	72	73	73																		
74	23.3																							72	72	73	74	74																
75	23.9																								72	72	73	74	75	75														
76	24.4																									72	72	73	74	75	76	76												
77	25.0																										72	72	73	74	75	76	77											
78	25.6																											72	73	74	75	76	77	77	78									
79	26.1																												72	73	74	75	76	77	78	79								
80	26.7																													72	73	74	75	76	77	78	79	80						
81	27.2																														72	73	74	75	76	77	78	79	80	81				
82	27.8																															72	73	74	75	76	77	78	79	80	81	82		
83	28.3																																72	73	74	75	76	77	78	79	80	81	82	83
84	28.9																																											84
85	29.4																																										85	
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Adapted from the University of Arizona, Dept. of Ag. Engineering

same time that it increases their nutrient requirements. Feed intake declines when ambient temperature exceeds 78 degrees F. The decrease in feed intake often reduces milk production, sometimes as much as 30 percent. Additionally, the production of milk components may shift, reproduction efficiency declines, and the cow's immune system is compromised.

Adjustments in nutrition management and in the cow's environment can help her overcome heat stress, encourage higher feed intake, and support higher milk production during the summer heat.

Nutrition Management Adjustments

Water Availability. Water is indisputably the most important nutrient for lactation, and it becomes even more essential when cows are under heat stress. In the lactating cow, water is necessary both for dissipating excess body heat and as a large component of milk (milk being 88 percent water). Under stress, cows will use much of their available body water to dissipate heat, thereby reducing the water available for milk production. National Research Council guidelines suggest that water needs are 1.2 to 2-fold greater in heat-stressed animals. Water can be limited either by poor quality or inadequate quantity.

A common problem on dairies is that water supplies are placed too far from the shade, feed bunks or other cooling systems. If cows have to choose between staying in the shade or walking out in the sun for water, they generally will stay in the shade. Fresh water should be readily accessible throughout cow traffic

areas to meet the additional water needs during summer heat.

Placing large water troughs along the exit lanes from the milking facility encourages water consumption and the return to the feed lane after milking.

Ration formulation adjustments. To modify summer rations, first adjust computer predictions of dry matter intake to **actual** feed intake. Then make additional adjustments to minimize the diet's contribution to heat load. Such changes may include 1) modifying the energy density by decreasing fiber and increasing fat, 2) balancing protein fractions, and 3) adjusting mineral levels appropriately.

➔ **Fiber.** Because cows eat less in the summer, dairy managers may attempt to maintain energy intake by decreasing the forage:concentrate ratio. This involves increasing the energy density of the diet while providing just enough fiber for normal rumen function. Forage digestion contributes significantly to the cow's heat load. Research has shown that during heat stress, cows reduce their intake less when diets contain 17 percent versus 20 percent acid detergent fiber (ADF), on a dry matter basis. Milk yield is also higher with the 17 percent ADF diet. However, one must be careful when lowering fiber in summer diets, especially when diets contain large amounts of by product feeds (brewer's grains, soybean hulls, hominy, etc.). While these contain higher levels of fiber than conventional concentrates, they may not be as effective as long forage fiber in maintaining rumen function. Current particle size distribution recommendations from the northeast U.S. suggest that 6 to

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10 percent of the total mixed ration (TMR) be longer than .75 inches. Byproducts and chopped, fermented forages are much smaller than this and can contribute to nutritional disorders such as displaced abomasum and sporadic diarrhea. When rations are adjusted, close attention should be paid to the final TMR particle size.

➔ **Fat.** Increasing dietary fat will increase the energy density of the diet and reduce body heat load. However, high fat levels in summer rations may reduce fiber digestion at a time when fiber is critical because of low feed intakes. Supplemental fat is most effective when fed in conjunction with high-quality forages. Guidelines for supplementing fat in the ration include:

- * 40 to 45 percent from basal feed ingredients
- * less than 30 to 40 percent of total fat from whole fat seeds
- * 15 to 20 percent from ruminally inert fats
- * less than 7.5 percent total dietary fat (DM basis)

While the ruminally inert fats can cost from 30 to 50 cents per cow per day, this may be justified during the summer months, especially with high producing groups. To evaluate the return on supplemental fats during heat stress periods, consider the effects on energy balance, body condition, and reproduction in addition to any increase in milk production.

➔ **Protein.** Research has not provided clear recommendations for protein nutrition under heat stress. It is known that the reduced dry matter intake during heat stress can cause a negative protein balance. For this reason,

actual feed intakes must be used in formulating rations.

Producers may increase the percentage of protein in summer rations in an attempt to maintain pounds of protein intake at lower feed intake levels. However, excess degradable protein in the diet requires the cow to use more energy to excrete the excess nitrogen. This places an additional drain on the cow's system. Therefore, rations should be formulated for pounds of protein intake, rather than just the percentage of dietary protein. It is also important to balance protein solubility, degradability, and bypass ability to prevent an unnecessary heat load addition on the animal.

➔ **Minerals.** Because cows eat less when heat stressed, it makes sense to adjust rations so that they contain the correct fortification levels. Electrolyte macrominerals (potassium and sodium) are very important in maintaining the water balance, ionic balance, and acid-base status of heat-stressed cows. Research from the University of Florida and The Texas A&M University System has demonstrated that milk yield increases with supplemental potassium and sodium. Based on this research, current field recommendations for mineral supplementation during periods of heat stress include:

- * 1.5 to 1.6 percent potassium
- * .45 to .60 percent sodium
- * .35 to .40 percent magnesium

Feeding management. Feed intake is the key to lactation performance at any time of the year. It is especially important during heat stress periods. Many strategies for maintaining feed intake during summer have been

evaluated, including using a total mixed ration, adding moisture to the ration, increasing the frequency of feeding, and feeding during the cooler parts of the day.

Adding water to the TMR is a common practice in the south, especially with rations formulated around dry hay. It is common to add moisture so that the dry matter is between 50 and 60 percent; with rations containing little or no wet feeds, this can mean adding 18 to 20 pounds of water per cow. Adding water or liquid molasses to the ration may prevent cows from sorting forages and grains in the feed bunk, but requires that bunks be managed to prevent soured feed during the summer heat.

Feeding during cooler parts of the day may help maintain feed intake. Florida research showed that heat-stressed cows with no access to cooling systems consumed about two-thirds of their daily intake during the cooler nighttime hours. This makes sense, as the heat associated with digestion peaks about 3 to 4 hours after feeding. Therefore, cows fed at 8:00 a.m. have peak digestive heat loads between 11:00 a.m. and noon, when the ambient temperature is high. Cows fed in the early morning (5:00 to 6:00 a.m.) have peak digestive activity between 8:00 and 9:00 a.m. and can dissipate some of the heat load before the day gets hot. Similarly, cows fed during the evening have their peak digestive heat loads during the cool of the night.

Environmental Adjustments

When evaluating cooling systems and their cost-effectiveness, consider factors such as region, facility design, and herd productivity. Both the type of

system and its location are important. The length and severity of the heat period will determine the cost-effectiveness of the system.

System type. The purpose of any cooling system is to help cows maintain as normal a body temperature as possible. This may not be possible during the middle of the day, but a cooling system can minimize increases in body temperature. In dry-lot dairies, exposure to direct sunlight at the feed lane can add a tremendous heat load to the cow. The easiest and most obvious way to help heat-stressed cows is to provide shade (minimizing solar radiation). Adding fans and sprinklers (evaporative cooling) in shaded areas can help even more. Research has shown that cows supplied with a combination of shade, fans and sprinklers produce 11 percent more milk than cows given shade alone.

Free-stall housing cooling systems should be run continuously during hot periods. For example, sprinklers should run for 1 to 3 minutes every 15 minutes, with overhead fans running the rest of the time. Fans are especially important in central and east Texas to reduce the humidity caused by sprinklers. It is important that sprinkler nozzles release water with sufficient force and droplet size to penetrate the hair and wet the cow's skin.

Location of cooling systems.

Cows may be cooled in several areas throughout the dairy. Table 1 illustrates how shaded feeding areas encourage greater eating frequency. Note the reduction in feed intake, as THI increased, with the corral shade placed away from the manger; this would suggest that cows made

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Table 1. The effects of shade on cow eating behavior (percent observed eating between feedings).

Temperature, (°F)	64	88	104
Relative humidity (%)	72	43	33
Shade type¹			
None	12	10	5
Corral shade	11	8	4
Corral shade + shaded fence line	21	17	18
Freestall	22	20	18

¹Corral shade types were: none; a solid strip roof (12 feet wide x 12 feet high); solid strip roof plus separate shaded fence line manger of similar dimensions; and a freestall facility.

Adapted from Large Dairy Herd Management, Van Horn and Wilcox, 1992.

When evaluating cooling systems in corrals, a rule of thumb is that increased milk production represents half of the total benefits.

the choice to stay in the shade rather than feed. However, when shade was placed over the feed lanes, eating patterns were maintained as THI increased.

While cooling at the feed lane or in the lounging area may be most common, it is also important to cool in the parlor holding pen. The high density of animals in a small, enclosed space with minimal air flow places a tremendous heat load on the cow at a time when milk let down is desired. Holding pen cooling systems commonly use low pressure sprinklers to soak the cows and large fans to evaporate the water off the cows' bodies. Cooling in this area of the dairy ensures that all cows in lactation are cooled down at least two or three times per day, depending on how often they are milked.

When evaluating cooling systems in corrals, a rule of thumb is that increased milk production represents half of the total benefits. Other benefits include better reproductive performance, lower culling percentage, and improved animal

health; however, it is difficult to put a clear-cut economic value on these.

Which groups to cool? Demonstration trials conducted in central Texas from June to September 1997 illustrate the importance of cooling the fresh cows and the higher producing cows (Table 2). In these trials, there were two groups of cows—early to mid-lactation cows and fresh cows. The early to mid-lactation cows were initially paired by milk production and days in milk. The fresh cows included pairs scheduled to calve during August. Both groups had sprinklers over the feed lane; however, the cooled group had supplemental high pressure coolers installed under the corral shades. The addition of corral shade cooling lowered the lounging environment 14 degrees for the cooled group and made a substantial difference in respiration counts for these animals, suggesting that the cooled cows experienced only minor heat stress. In this trial, the cooled cows had 12 percent greater feed intakes and an 11 percent increase in milk yield.

Table 2. Response of cows to cooling in Central Texas.

Parameter	Control	Cooled ¹
Shade temperatures (°F)	95	81
Respiration counts (breaths per minute)	97	51
Dry matter intake (lbs./cow/day)	50	56
Milk, early to mid-lactation group average (lbs./cow/day)	66	73
Milk, fresh group average (lbs./cow/day)	69	78

¹Cooled cows had supplemental shade cooling provided by a high pressure misting system.

While most of the emphasis has been on cooling the lactating cow because of her intense metabolic heat production, another critical period is the dry period. This is the time of mammary gland regression and subsequent development, as well as rapid fetal growth. While the metabolic heat production is relatively low at this time, it is possible that the endocrine system is more sensitive to moderate heat stress during the dry phase than during lactation. Research suggests that relieving heat stress can increase calf birth weight by 8 percent and increase milk production at 150 days by as much as 8 pounds.

Summary

Management is the key to maintaining acceptable summer milk production. Bunk management practices should attract the cow to the feed lane. Attention to detail in nutrition, feeding management, and cow comfort will minimize the effects of summer heat stress. Many summer ration modifications (lowered forage:concentrate ratios, higher grain feeding) increase the risk of nutritional upsets. All ration changes should be made with careful attention to bunk man-

agement and daily feed intakes. Close observation of animal response (intakes, tank averages, and manure consistencies) will allow you to find your herd's best ration for summer performance.

Points to Remember

Feeding management adjustments

- * Provide ready access to fresh water throughout the facility.
- * Manage rations to prevent sorting of grains and forages.
- * Formulate rations on actual feed intakes.
- * Increase the number of times cows are fed.
- * Feed during the cooler times of the day.
- * Keep feed bunks clean and fresh.

Environmental adjustments

- * Supply adequate cooling in parlor holding facilities.
- * Provide additional shade and/or cooling over the feed lanes to attract cows to mangers.

Don't forget the dry cows!

Management is the key to maintaining acceptable summer milk production.

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