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Coping with summer weather: management strategies to control heat stress (1996)

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COPING WITH SUMMER WEATHER: MANAGEMENT STRATEGIES TO CONTROL HEAT STRESS

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Summary

Heat stress occurs when a dairy cow's heat load is greater than her capacity to lose heat. The effects of heat stress include: increased respiration rate, increased water intake, increased sweating, decreased dry matter intake, slower rate of feed passage, decreased blood flow to internal organs, decreased milk production, and poor reproductive performance. The lower milk production, and reproductive performance cause economic losses to commercial dairy producers. This review will discuss methods that can be used on commercial dairy farms to reduce the effects of heat stress on dairy cattle.

(Key Words: Heat Stress, Summer, Cooling.)

Measuring Heat Stress

The severity of heat stress usually is quantified by a temperature humidity index (THI). Both ambient temperature and relative humidity are used to calculate a THI. A THI above 72 is associated with heat stress in dairy cattle. The THI's at various temperatures and relative humidities are presented in Figure 1. Dairy producers can purchase a thermometer/hygrometer and use Figure 1 to determine the level of heat stress at different locations on the dairy.

Heat Loss in Dairy Cows

Dairy cows dissipate heat in several ways, including conduction, convection, radiation, and evaporative cooling. Conduction is based on the principal that heat flows from warm to cold. This method of heat loss requires physical contact with surrounding objects. An example of conductive cooling would be when a cow wades into a pond of water. Cooling by convection occurs when the layer of air next to the skin is replaced with cooler air. Radiation of body heat can occur when the ambient temperature is significantly cooler than the cow. At cooler temperatures, dairy cattle are efficient at radiating heat. Evaporative cooling occurs when sweat or moisture is evaporated away from the skin or respiratory tract. This is why dairy cattle perspire and increase respiration rates during heat stress. High humidity limits the ability of the cow to take advantage of evaporative cooling. When the ambient temperature is under 50 degrees F, non-evaporative methods of cooling account for 75% of the heat loss. At temperatures above 70 degrees F, evaporative cooling is the cow's primary mechanism for heat loss. Dairy producers can take advantage of the same mechanisms to cool dairy cows on the farm.

Water Availability

Providing access to water during heat stress is critical. Lactating dairy cattle will typically require between 35 and 45 gallons of water per day. Studies completed in climatic chambers indicate that water needs increase 1.2 to 2 times when cows are under heat stress. A water system needs to be designed to meet both peak demand and daily needs of the dairy. Making water available to cows leaving the milking parlor will increase water intake by cows during

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heat stress. Access to an 8-ft water trough is adequate for milking parlors with less than or equal to 25 stalls per side. When using drylot housing, we recommend having water troughs at two locations and 30 ft of trough perimeter per 100 cows or 80 ft of trough perimeter for 200 cows. In free-stall housing, one waterer or 2 ft of tank perimeter is adequate for every 15 to 20 cows. An ideal situation would be to have water available at every crossover between feed and resting areas.

Shades

Cows housed in drylot or pasture situations should be provided with solid shade. Research from Florida and Arizona indicates that when high-producing cows are exposed to direct sunlight and a THI exceeds 80 during daylight hours, shaded cows will produce approximately 4 to 5 lb of additional milk per day. Natural shading provided by trees is effective, but most often shades are constructed from solid steel or aluminum. Providing 38 to 45 square ft of solid shade per mature dairy cow is adequate to reduce solar radiation. Shades should be constructed at a height of a least 12 ft with a north-south orientation to prevent wet areas from developing under them. Using more porous materials such as shade cloth or snow fence is not as effective as solid shades.

Holding Pen

The holding pen is where dairy cows probably experience the most heat stress. Putting cows into a holding pen is similar to putting several large furnaces into a small area with the thermostat stuck on 100 degrees F. On most days, cows would benefit from shade over the holding pen and open-sided holding areas to provide ventilation. Installing fans will help ventilate the holding pen. The level of heat stress in the holding pen can be measured by holding a thermometer/hygrometer on a long rod over the top of the cows to determine the temperature and relative humidity. These values then can be used to determine a THI from Figure 1.

Cows can be cooled in the holding pen before milking. This method uses low volume sprinklers to wet cows and large fans to hasten evaporation of the water. In this way, cows are cooled as often as they are milked. Both spray and fans should be operated continuously using approximately 1000 CFM of air per cow per hour. Fans should be mounted overhead at a 30 degree angle from vertical, so that the air will blow down on cows. Water lines in front of the fans spray 7 to 10 gallons of water per hour at 125 to 150 PSI. Fans of 36- to 48-inch diameter are used most commonly. In an Arizona study, body temperature was lowered 3.5 degrees F resulting in 1.7 lb of extra milk per day per cow cooled in the holding pen. Fans and water spray should be used during the summer months whenever the ambient temperature exceeds 80 degrees F (day or night). There also is an advantage in using the fans only when the temperature is between 80 and 90 degrees F.

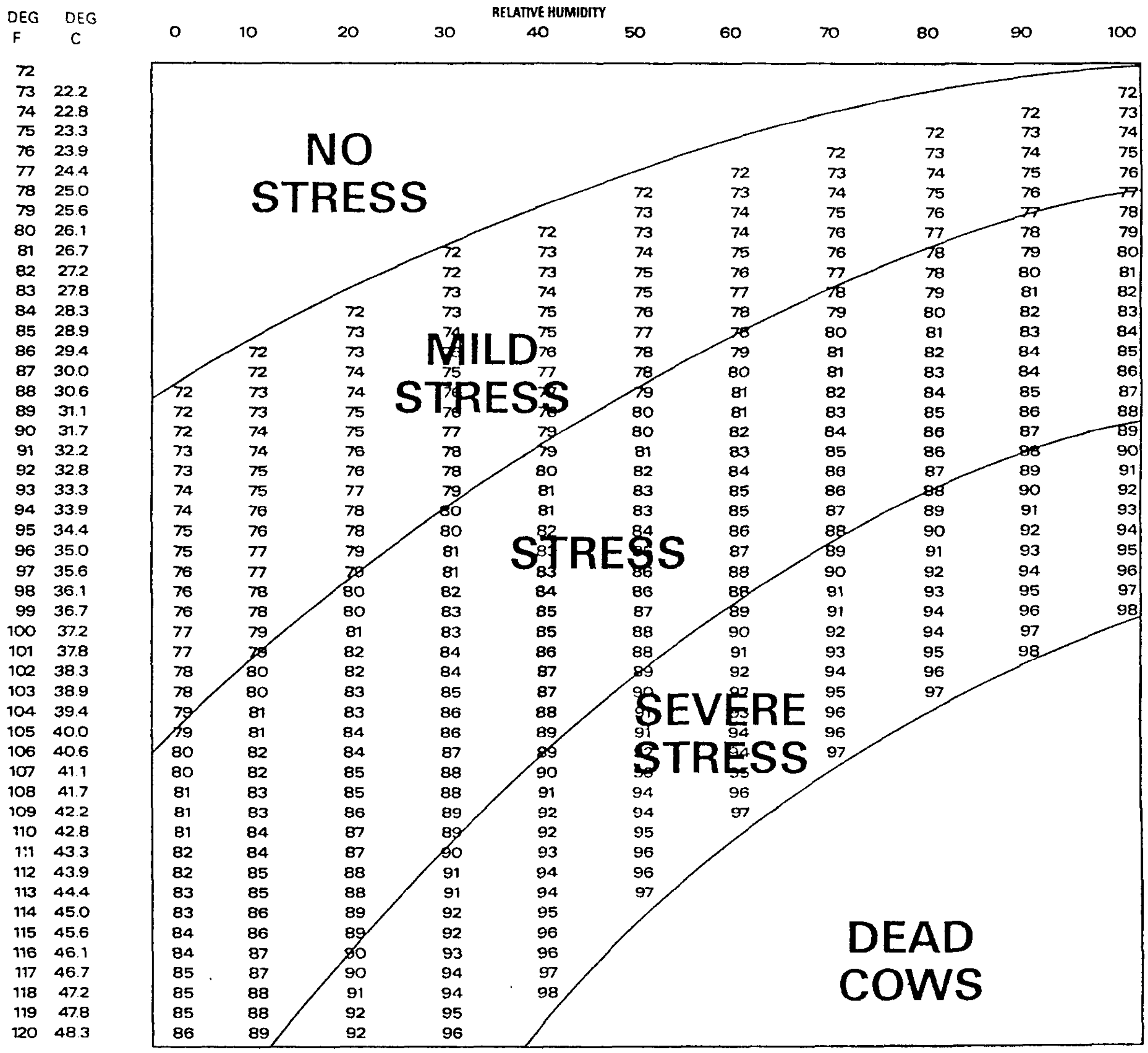
Exit Lane Cooling

Cows can be cooled as they exit the parlor. Typically three to four nozzles are installed in the exit lane, with a delivery of approximately 8 gallons of water per minute at 35 to 40 PSI. The nozzles are turned on and off with an electric eye or wand switch as the cow passes under the nozzles. If properly installed, the top and sides of the cow are wet but the head and udder will remain dry, so water will not interfere with postmilking teat dipping.

Free Stalls

Free-stall housing should be constructed to provide good natural ventilation. Sidewalls should be 12 to 14 ft high to increase the volume of air in the housing area. The sidewalls should be able to open a minimum of 50% and preferably 75 to 100%. Fresh air should be introduced at the cow's level. Curtains on the sides of free-stall barns allows greater flexibility in controlling the ventilation. Because warm air rises, steeper sloped roofs provide upward flow of warm air. However, roofs with slopes steeper than a 6:12 pitch prevent incoming air from dropping into the area occupied by the cows. Roofs with slopes less than 4:12 may cause condensation and higher internal temperatures in the summer. Roof slopes for free-stall housing should range from 4:12 to 4:16. Providing openings in end walls and alley doors will improve summer ventilation. Gable buildings should have a continuous ridge opening to allow warm air to escape. The ridge opening should be 2 inches for each 10 ft of building width. Naturally ventilated buildings should be spaced a minimum of 50 ft apart.

Additional cooling in free-stall areas can be provided by adding fans and a sprinkler system. Free-stall bedding or sand must not become wet. Typically, a sprinkler system could be located over the lockups, and fans could be used over the free stalls, lockups, or both. The sprinkler system can be put on a timer to reduce water usage.



DEG F	DEG C	RELATIVE HUMIDITY 0	10	20	30	40	50	60	70	80	90	100
72												
73	22.2											72
74	22.8										72	73
75	23.3									72	73	74
76	23.9								72	73	74	75
77	24.4							72	73	74	75	76
78	25.0						72	73	74	75	76	77
79	25.6						73	74	75	76	77	78
80	26.1					72	73	74	76	77	78	79
81	26.7				72	73	74	75	76	78	79	80
82	27.2				72	73	75	76	77	78	80	81
83	27.8				73	74	75	77	78	79	81	82
84	28.3			72	73	75	76	78	79	80	82	83
85	28.9			73	74	75	77	78	80	81	83	84
86	29.4		72	73	[illegible]	76	78	79	81	82	84	85
87	30.0		72	74	75	77	78	80	81	83	84	86
88	30.6	72	73	74	76	[illegible]	79	81	82	84	85	87
89	31.1	72	73	75	76	78	80	81	83	85	86	88
90	31.7	72	74	75	77	79	80	82	84	86	87	89
91	32.2	73	74	76	78	79	81	83	85	86	88	90
92	32.8	73	75	76	78	80	82	84	86	87	89	91
93	33.3	74	75	77	79	81	83	85	86	88	90	92
94	33.9	74	76	78	80	81	83	85	87	89	91	93
95	34.4	75	76	78	80	82	84	86	88	90	92	94
96	35.0	75	77	79	81	83	[illegible]	87	89	91	93	95
97	35.6	76	77	79	81	83	86	88	90	92	94	96
98	36.1	76	78	80	82	84	86	88	91	93	95	97
99	36.7	76	78	80	83	85	87	89	91	94	96	98
100	37.2	77	79	81	83	85	88	90	92	94	97	
101	37.8	77	79	82	84	86	88	91	93	95	98	
102	38.3	78	80	82	84	87	89	92	94	96		
103	38.9	78	80	83	85	87	90	92	95	97		
104	39.4	79	81	83	86	88	91	93	96			
105	40.0	79	81	84	86	89	91	94	96			
106	40.6	80	82	84	87	89	[illegible]	94	97			
107	41.1	80	82	85	88	90	[illegible]	[illegible]				
108	41.7	81	83	85	88	91	94	96				
109	42.2	81	83	86	89	92	94	97				
110	42.8	81	84	87	89	92	95					
111	43.3	82	84	87	90	93	96					
112	43.9	82	85	88	91	94	96					
113	44.4	83	85	88	91	94	97					
114	45.0	83	86	89	92	95						
115	45.6	84	86	89	92	96						
116	46.1	84	87	90	93	96						
117	46.7	85	87	90	94	97						
118	47.2	85	88	91	94	98						
119	47.8	85	88	92	95							
120	48.3	86	89	92	96							

Figure 1. **Temperature Humidity Index at Various Combinations of Temperature and Relative Humidity**