

An example of solid strip shade in the corral and uncovered feed mangers — the most common shade arrangement in the study area.



Dairy cow corral behavior

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Rotted areas of tomatoes are dark green, brown, or brownish black and "greasy" with a firm, wrinkled surface.



In moist weather, the fungus sporulates on lesions as a whitish gray downy growth, mostly on lower leaf surface.

The corral confinement system used for intensive dairying in the Central Valley and southern California subjects the cow to various types of stress, particularly following parturition and during peak lactation. The effect of weather on these animals is of primary concern, especially in the hot, dry summer, when temperatures average highs of 95° F, with numerous days over 100° F, and relative humidity averaging 33 percent. Winters in the area are usually cool and mild; spring and fall are moderately warm.

Several types of shade have been constructed in the corrals to alleviate weather stress on the cow. The most common is a solid strip roof, 12 feet wide and 12 feet above the ground, with no walls. Increasing numbers of dairies are installing completely roofed free-stall barns without walls for the combined resting and feeding area. Some dairies have variations of these shade types, and others have no shades.

Behavior of individual cows visually monitored in small groups reflects adaptation responses to stressful conditions. Also, time-lapse photography of small numbers of cows in comparatively good environmental conditions has shown that the high-producing dairy cow voluntarily consumes feed a dozen times in 24 hours; each feeding lasts 10 to 12 minutes with an average of 90 minutes between feedings.

Relatively little information exists on cow behavior in large commercial dairy units where each corral may have 100 cows moving about freely. The objectives of this study were to develop an

observation method suitable for recording activity under such circumstances and to evaluate the effects of weather and shade type on behavior at different times of the year.

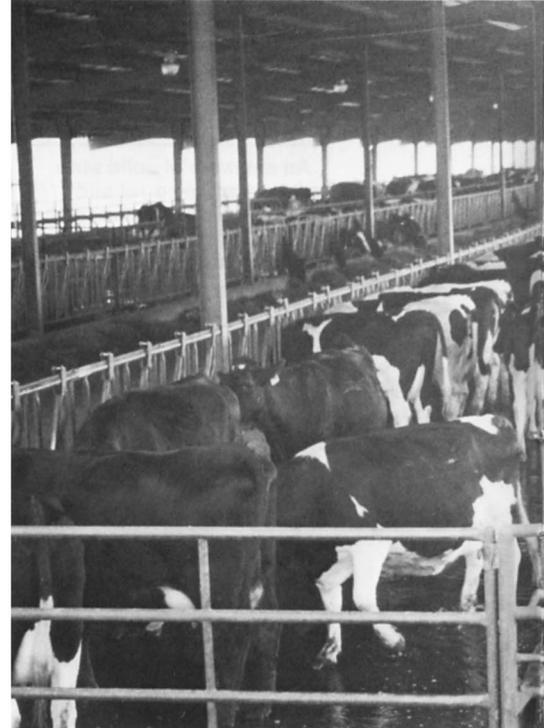
Cows were studied on eight dairies milking twice a day with production averages of 18,500 pounds of milk per cow yearly at 3.5 percent butterfat test. Observations were in the high-production corrals, which averaged 88 cows with a daily milk yield of nearly 90 pounds per cow. Each of the following shade types was represented by two dairies: no shade; solid strip roof, 12 feet wide and 12 feet high with no walls; similar strip roof plus a separate shaded manger feeding area; and completely shaded free-stall combined resting and feeding area. All dairies fed quality alfalfa hay, cereal silage, and concentrates in similar feeding routines offering fresh feed four times daily. Observations were grouped by weather type (see table 1).

One person visually scanned the corral at 15-minute intervals from 6:00 a.m. until 6:00 p.m. Five minutes per scan

TABLE 1. Average temperatures during dairy observations

Condition	Weather type*		
	Cool	Warm	Hot
	°F		
Unshaded, 7 a.m.	46	61	71
Shaded, 7 a.m.	46	59	67
Unshaded, 3 p.m.	64	88	104
Shaded, 3 p.m.	61	83	95

*Averages of 24 days.



Strip shade plus shade over manger to protect feed and cows. In center is a free-stall barn with shaded rest and feed area.

were sufficient to observe all animals. By walking around the corral perimeter, the observer could easily see without disturbing their activities, regardless of grouping patterns. Activities monitored included eating, resting, ruminating, drinking water, or lingering around water without drinking. Also noted was whether cows were in sun or shade and standing or lying. Resting was defined as any moment the cow was not eating, drinking, ruminating, or being milked. Sun and shade temperatures, milking and feeding times, and other pertinent information were also recorded. Activities were later tabulated as a percentage of cows present and averaged by shade and weather type.

TABLE 2. Average daytime percentage of cows eating*

Shade type	Weather type		
	Cool	Warm	Hot
None	34	27	21
Strip	37	25	24
Strip and manger	41	32	25
Covered free-stall	37	33	32

*Averages of 90 observations.

The observations revealed both general trends and details of cow behavior. Cows spent less time eating during the daytime as the weather became hotter (table 2). The decrease was most noticeable for nonshaded corrals and strip-shade pens with unprotected feed mangers. This behavioral pattern primarily occurred in the afternoon on hot days

TABLE 3. Cows eating when feed offered*

Feeding time & shade type	Weather type		
	Cool	Warm	Hot
	----- % -----		
Morning feed			
None	93	93	86
Strip	90	91	91
Strip and manger	89	88	89
Covered free-stall	66	65	64
Afternoon feed			
None	99	94	85
Strip	86	67	40
Strip and manger	72	73	86
Covered free-stall	69	65	66

*Averages of 18 observations.

(table 3). The response of nonshaded cows to fresh feed dropped 14 percent on hot afternoons, while the strip-shaded cows with unshaded mangers reduced their response by more than 50 percent. Under these conditions, feeding at cooler morning and evening hours was required to maintain desired feed intake levels.

It is noteworthy that cows with strip shades plus protected mangers actually increased their eating in hot weather. Also, the percentage of cows eating fresh feed in the completely shaded free-stall was generally lower than in other shade types but was nearly constant in morning or afternoon, regardless of weather.

Both shade types with protected mangers had twice the percentage of cows eating between fresh feed offerings during cool and warm weather and triple the figure in hot weather in comparison with unshaded manger corrals (table 4).

TABLE 4. Cows eating between feed offerings*

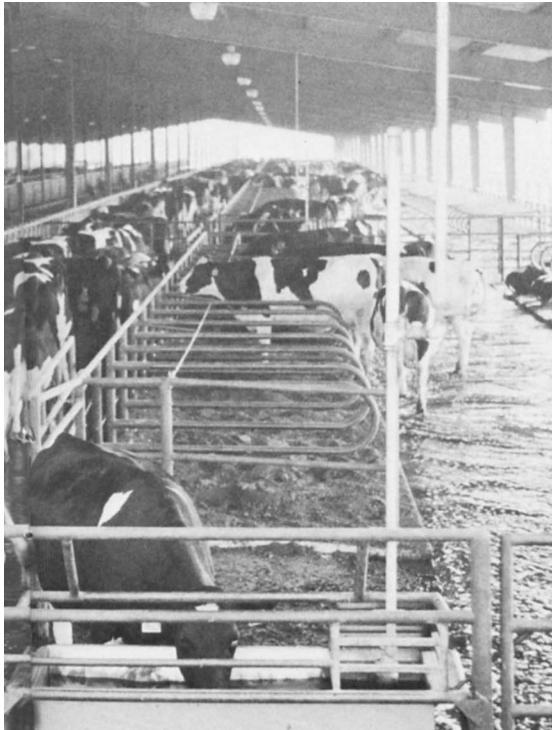
Shade type	Weather type		
	Cool	Warm	Hot
	----- % -----		
None	12	10	5
Strip	11	8	4
Strip and manger	21	17	18
Covered free-stall	22	20	18

*Averages of 48 observations.

It was apparent that this response was due to maintaining feed palatability as well as protecting the cows from the heat. This was particularly true for fermentable feedstuffs such as silage but was also noticed with dry leafy alfalfa hay. Since concentrates were mixed with the silage, their intake was also affected by prevailing weather conditions.

While the cows decreased daytime feed consumption in hot weather, they increased their resting time, particularly in the nonshaded and strip-shaded corrals with uncovered mangers (table 5). A minor decrease in daytime rumination was also observed as the weather became hotter, except in strip shade with unprotected mangers, where this activity increased slightly on hot afternoons (table 5).

Regardless of shade type, cows first ate fresh feed, then drank water, stood for a while, and later ruminated in the standing or lying position with rumination stopping periodically. The percentage of cows standing while resting or ruminating increased as temperatures rose. These factors were found to be



Corral at right provides no shade for the cows. Temperatures in the area often exceed 100°F.

highly correlated. The effect was most evident for the cows with no corral shade or with strip shades but unprotected mangers, and least apparent for animals with strip shade plus covered mangers or with a completely shaded free-stall rest and feed area. These observations suggest that standing increased dissipation of body heat as cows with less shade attempted to adapt to increased temperatures.

The percentage of unshaded cows drinking water and lingering around the water trough without drinking increased significantly as temperatures increased (table 6). Unshaded animals crowded around water troughs in the afternoon when peak temperatures were reached. As the crowding intensified, breathing became labored, but the cows remained stationary around the trough for at least an hour before moving to another area of the corral.

The limited number of dairies observed in this study does not permit

TABLE 5. Average daytime percentage of cows resting and ruminating*

Activity and shade type	Weather type		
	Cool	Warm	Hot
	----- % -----		
Resting			
None	40	47	51
Strip	41	52	50
Strip and manger	32	41	41
Covered free-stall	35	41	42
Ruminating			
None	24	23	19
Strip	20	20	24
Strip and manger	23	24	20
Covered free-stall	25	23	22

*Averages of 90 observations.

TABLE 6. Average daytime percentage of cows drinking water or lingering near water but not drinking*

Activity and shade type	Weather type		
	Cool	Warm	Hot
	----- % -----		
Drinking water			
None	1.6	1.9	3.7
Strip	1.9	2.2	2.1
Strip and manger	2.2	2.0	2.6
Covered free-stall	1.9	2.1	2.7
Lingering			
None	1.0	1.8	5.9
Strip	1.1	1.3	1.5
Strip and manger	1.7	1.5	1.8
Covered free-stall	1.4	1.7	2.3

*Averages of 90 observations.

positive ranking of shade types. However, milk production and reproductive efficiency, based on average days in milk, deteriorated by 11 and 3 percent respectively, in the unshaded dairies during hot weather. Milk yield of shaded cows dropped 5 percent during hot weather, but reproduction status was unchanged. These findings suggest that the skillful management on high-production dairies and/or other factors can mask weather stress effects, but efficiency may still be reduced.

The large number of observations on cow behavior by the visual monitoring method does allow suggestions for changes, in addition to feeding management decisions already mentioned, which might reduce stress and improve production and reproduction efficiency. Cows tended to go to the feed manger upon returning from milking, regardless of shade status. Data pooled from all dairies studied showed that when appe-

TABLE 7. Effects of access to feed on post-milking activity in corral*

Feed availability and cow activity	Minutes after milking			
	15	30	45	60
Near end of milking	----- % -----			
Eating	100	86	73	67
Standing	0	14	22	27
Lying down	0	0	5	6
One hour or more after milking				
Eating	11	18	18	21
Standing	75	55	48	26
Lying down	14	27	34	53

*Averages of 192 observations.

tizing feed was available in the corral manger immediately following milking, the cows ate, then drank, and then remained standing for about an hour before lying down. If cows did not have access to feed, about half would lie down shortly after milking (table 7). Since the teat sphincter gradually closes during a one-hour post-milking period, feeding management could be an added factor in mastitis prevention.

It can be concluded that activities of dairy cows, grouped and corralled in large numbers, can be visually monitored to record various behavioral patterns. These observations can be used to make management decisions that will improve dairy efficiency.

Thomas A. Shultz is Farm Advisor, Cooperative Extension, Tulare County, Visalia. The author acknowledges John Soares, staff field assistant, who helped compile data, and the following dairies: Cardoza Brothers and Sons, Tipton; Wilbur Brothers, Felipe Ribeiro and Sons, and Lone Palm Holsteins, Tulare; Egerly Farms, Dinuba; William Van Beek and Case DeJong, Visalia; and Norman Martin, Stratford.