EFFECT OF HEAT STRESS ON DAIRY CATTLE PERFORMACE A. PHYSIOLOGICAL ASPECTS

by

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Environmental factors play a major role in the seasonal decline in milk yield during summer months. Some of this decline is due to events occurring prepartum and some postpartum. Lets examine both aspects.

Prepartum Factors

Last year we demonstrated that the milk production of the cow is related to the birth weight of the calf. Cows giving birth to large calves gave more milk in a 305 day lactation than cows giving birth to small calves. Furthermore, heat stress during pregnancy reduced calf birth weight and postpartum milk yield of the dam. Cows housed under a shade structure the last trimester of pregnancy gave birth to larger calves than cows with no access to shade and went on to produce more milk during a 305 day lactation (Table 1).

Table 1. Effect of Heat Stress Prepartum on Calf Birth Weight and Maternal Milk Yield Postpartum

	Control	Heat Stressed
Birth Weight (kg)[a]	39.68	36.64
100 day Milk Yield (kg)	2672.4	2556.0
Pd 305-Day Yield[b]	6752.8	5948

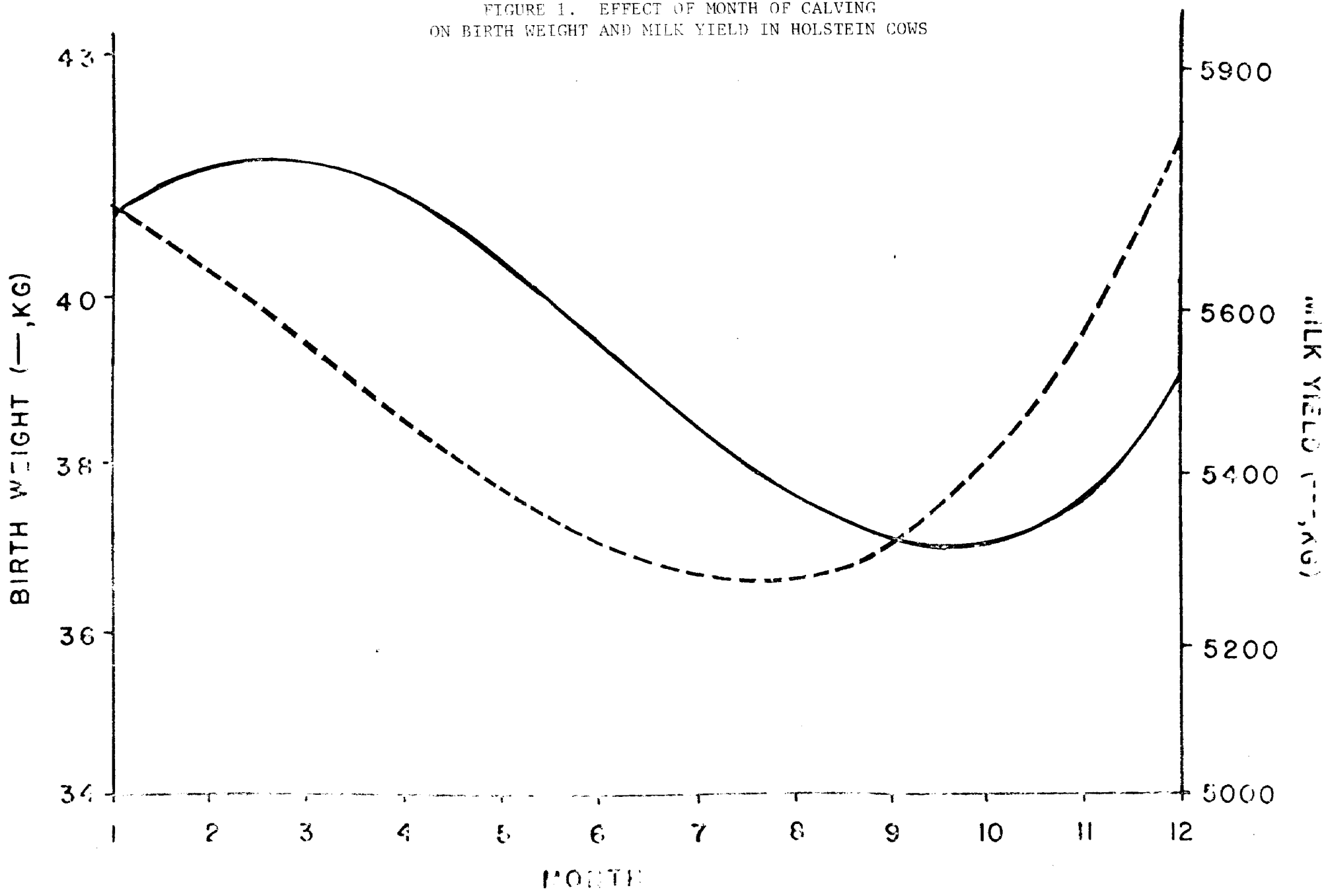
[a]Heat stressed different than controls $P<.05$

[b]Predicted yield adjusted for age, and month of calving.

Presumably this effect of heat stress on milk yield is caused by a reduction in mammary growth because in heat stressed cows the placenta is putting out less hormones which cause development of the gland. If this is related to the seasonal trend in milk yield, there should be a seasonal trend in calf birth weight. We have examined 1000 calvings over a 23 year period in Holstein cows. The month trend in birth weight and dams milk yield is shown on Figure 1.

There is indeed a month trend in birth weight of Holstein calves with the lowest birth weight accurring at the end of summer. Apparently, the longer a cow is heat stressed during pregnancy the smaller the size of the calf. As can be seen, the month trend in birth weight is not

FIGURE 1. EFFECT OF MONTH OF CALVING
ON BIRTH WEIGHT AND MILK YIELD IN HOLSTEIN COWS



identical to the month trend in milk yield. This is due to the postpartum effects of heat stress on lactation itself. Prepartum events are influencing the cows ability to produce milk. However, postpartum stress also plays a role. Thus, cows calving in June and July have the combined problem of low calf birth weight and heat stress during lactation which causes them to produce the least milk in a 305 day lactation. How does heat stress effect the cow postpartum.

Postpartum Factors

As stated earlier, heat stress adversely affects lacation. This occurs by a number of mechanisms. The first effect is to raise body temperature which results in reduced feed intake, and basal metabolism. Rumen function is also altered. Figure 2 illustrates rectal temperatures around a 25 hour period in Holstein cows having access to shade or denied shade. Zero in this graph corresponds to twelve o'clock and 25 to noon the following day. Not only is rectal temperature elevated, rumen temperature is also increased, Figure 3. We examined rumen pH and found it to be lower in no shade cows, Figure 4. Although rumen pH was lower in heat stressed cows, it was not due to an increase in volatile fatty acid content of the rumen. This is depicted in Figure 5. Note that volatile fatty acid content rises in both groups following feeding, marked "F" on the graph, however shade animals maintain a higher concentration after the initial rise which may reflect differences in feed intake. Associated with the lower concentration of volatile fatty acids there is an alteration in pattern of rumen fermentation as shown in Figure 6. The actetate to propronate ratio is lower in heat stressed cows. Thus, shade management during warm weather has dramatic effects on rumen function and feed intake. This is reflected in higher milk production of cows having access to shade.

How much shade should be provided to cows? The answer is, as much as possible. We have examined Black Globe temperatures under 70% or 90% shade cloth and compared them to temperatures in the no shade area and under our insulated shade structure. The shade cloth was kindly provided by Donovan Enterprises, Palm City, Florida. As shown in Table 2, Black Globe temperatures are reduced by shade cloth. However, 90% shade would provide the greater protection for cows. Although more expensive the insulated shade reduced temperature the most.

Table 2. Effect of Shade Type on Black Glode Temperature

	Sun	Shade Structure	Shade Cloth 90%	Shade Cloth 70%
Black Globe Temp °C	38.78	30.05	33.60	34.12

How important are these differences in Environmental temperature. Evidence to date suggests that cows faced with afternoon Black Globe temperatures of 35°C produce 1.5 kg less milk per day per cow than cows at 30°C. Cows exposed to temperatures averaging 40°C produce 3 kg less milk per day. Thus, a dairy farmer with 100 cows which are exposed to afternoon temperatures averaging about 38°C is losing close to $100 a day in milk. It is fairly easy to see that investing a little extra money to get maximum shade will pay for itself.

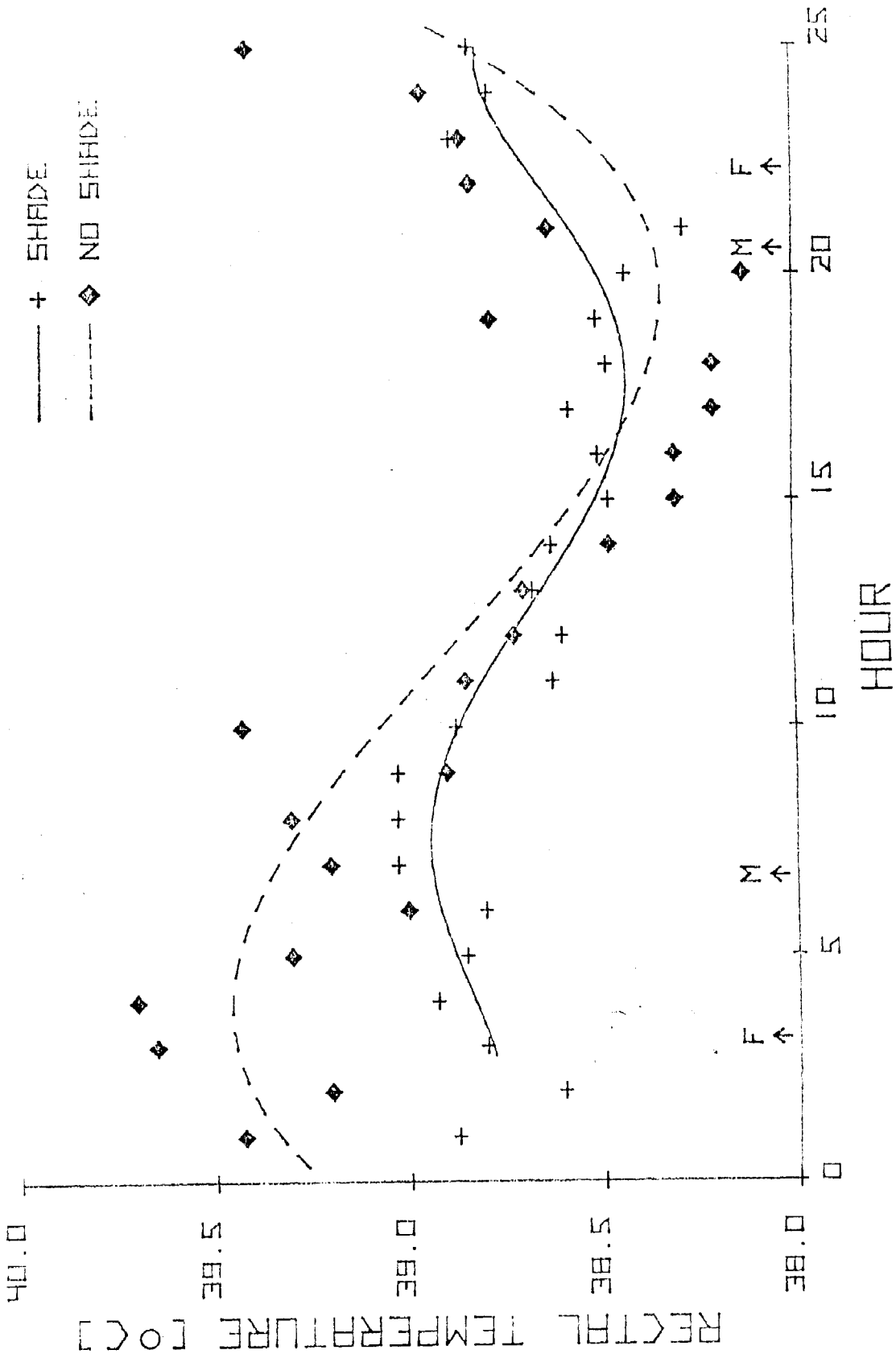


FIGURE 2. EFFECT OF SHADE ON RECTAL TEMPERATURE IN HOLSTEIN COWS

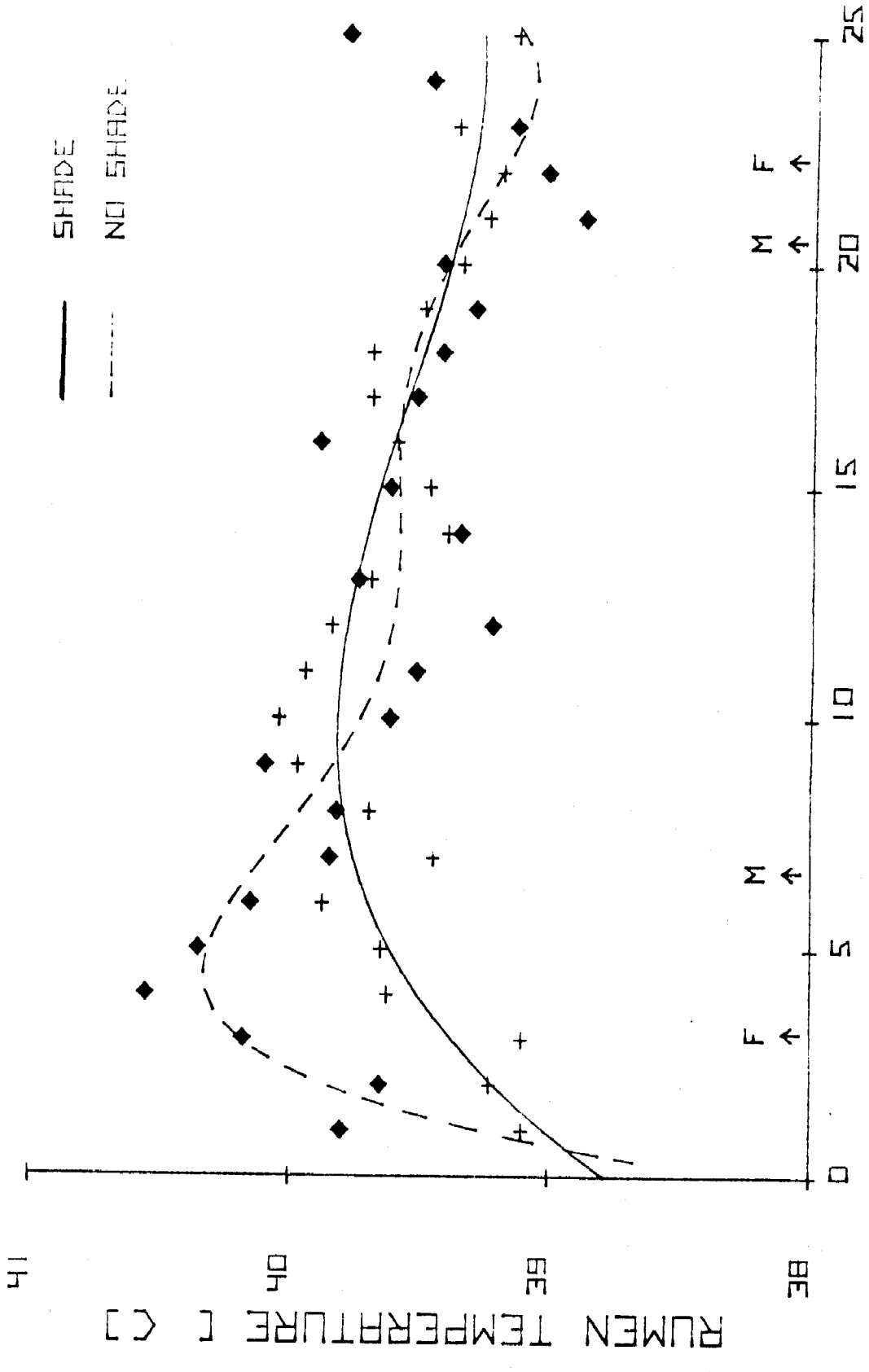


FIGURE 3. EFFECT OF SHADE ON RUMEN TEMPERATURE IN HOLSTEIN COWS

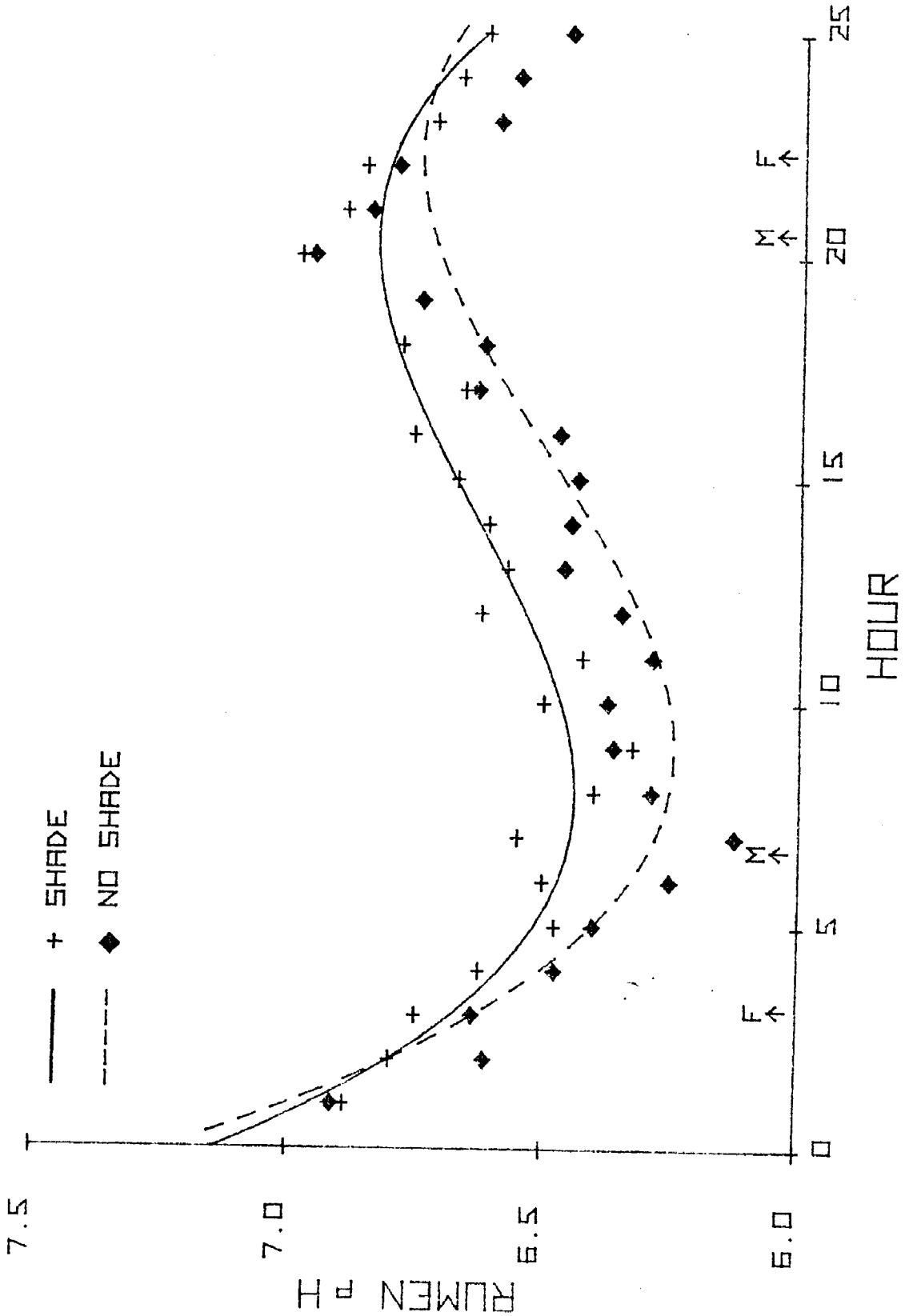


FIGURE 4. EFFECT OF SHADE ON RUMEN pH IN HOLSTEIN COWS

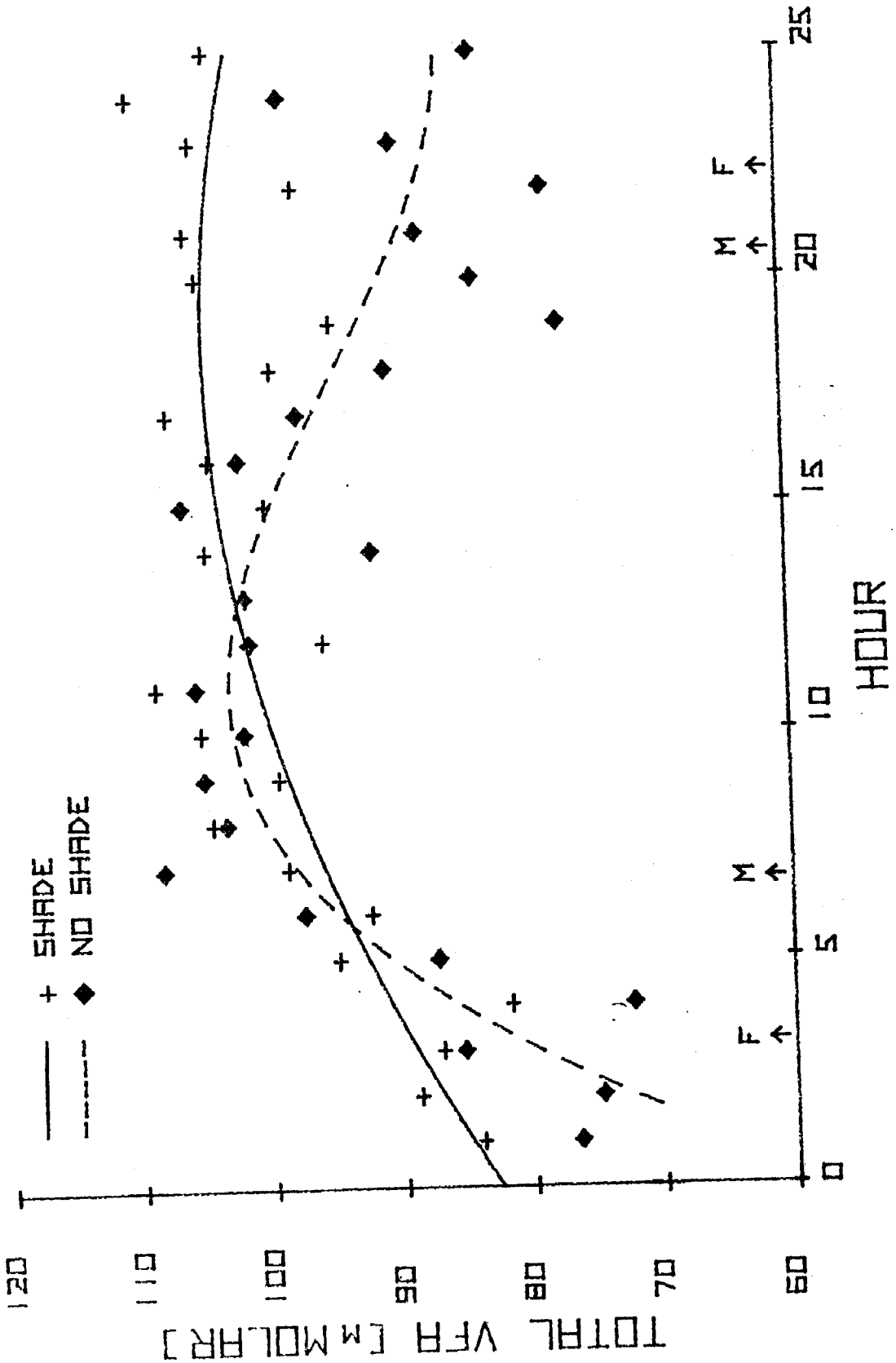


FIGURE 5. EFFECT OF SHADE ON TOTAL VOLATILE FATTY ACID CONCENTRATION IN RUMEN FLUID OF HOLSTEIN COWS

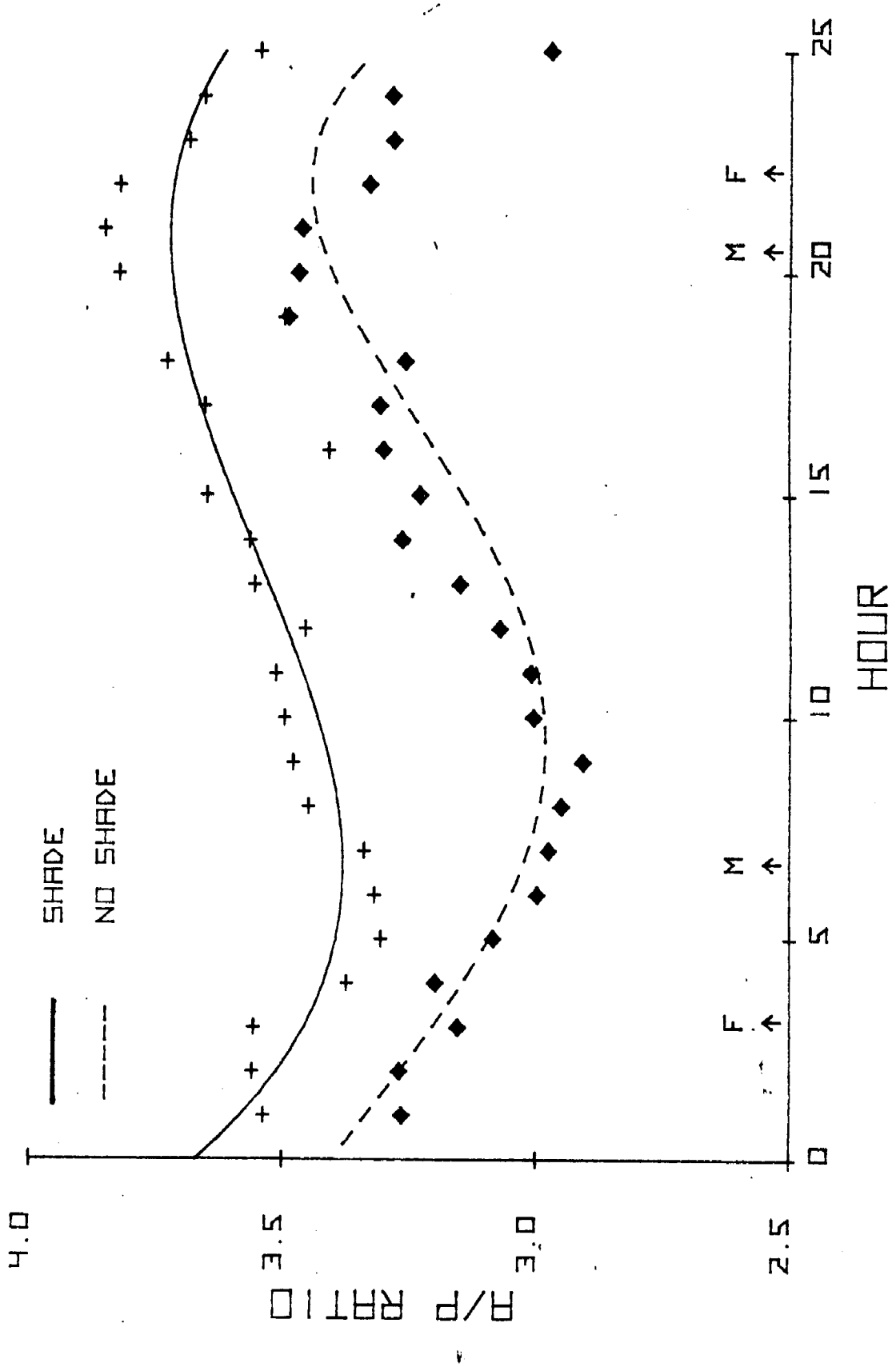


FIGURE 6. EFFECT OF SHADE ON ACETATE/PROPIONATE RATIO IN RUMEN FLUID OF HOLSTEIN COWS