ECONOMICS OF COOLING COWS TO REDUCE SEASONAL VARIATION IN PEAK MILK PRODUCTION

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Summary

The economic impact of cooling cows to reduce the seasonal variation in peak milk production was estimated using research-based lactation curves and peak production numbers for a commercial dairy operation in Kansas. Reducing the seasonal drop in peak production that occurs in the late summer and fall months by 29% or more is profitable for second or higher lactation cows. This reduction represents an increase in total milk production over the entire lactation of slightly over 1% and an increase in the average annual peak production of only 1 lb. This indicates that achieving at least the breakeven level for second and higher lactation cows is a reasonable expectation. Based on the peak milk production for the farm considered in this analysis, it would not pay to cool first lactation cows, because their peak production was lower and exhibited very little seasonality. The economics of cooling cows is insensitive to feed prices, and only moderately sensitive to milk prices suggesting that the decision to cool dairy cows is basically independent of these factors. Although the benefit of cooling dairy cows, in terms of increased production, will depend on the type and effectiveness of the cooling system used, this analysis indicates that even small improvements in production can be economical.

(Key Words: Economics, Heat Stress, Cooling Cows.)

Introduction

Heat stress can have a large impact on cow comfort and milk production, thereby impacting the profitability of dairy operations. Drops in milk yield of 10-25% following heat stress are not uncommon in high-producing herds. With production decreases of this magnitude, providing supplemental cooling to avoid, or at least minimize, the impact of heat stress, most likely will be economical. However, in order for producers to make informed decisions, they need quantitative information; thus, an economic analysis that quantifies the returns associated with cooling cows (i.e., heat-stress abatement) is warranted.

Studies examining the returns to reducing heat stress often consider the heat-stress time period only. However, published lactation curves suggest that a 1-lb increase at peak production will produce an additional 225 to 250 lb of milk over the entire lactation. Therefore, any economic analysis of heat-stress abatement should account for the increased production over a cow's entire lactation. The purpose of this study was to estimate the economic returns associated with reducing, or even eliminating, seasonal variation in peak milk production for a commercial dairy herd in Kansas using a hypothetical research-based milk lactation curve to simulate milk production and the costs associated with a fan and sprinkler-based cooling system.

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Procedures

A partial budget was used to examine the impact of heat-stress abatement (i.e., adding cooling equipment) on net returns. A partial budget includes four values: 1) increased revenue, 2) decreased costs, 3) increased costs, and 4) decreased revenue. For the dairy analyzed here, increased revenue is simply the increased milk production from reducing heat stress. Quantifying the costs expected to decrease from reducing heat stress is difficult, and such costs likely vary considerably between operations. Costs that might decrease as a result of reduced heat stress are those associated with health and reproduction, i.e., those factors directly related to cow comfort. Because of the difficulty in measuring these costs accurately, they are not included in this analysis, and as a result the returns associated with heat-stress abatement should be viewed as lower bounds. Increased costs associated with cooling cows are the higher feed costs from increased feed intake and fixed and variable costs of the cooling system itself (depreciation and interest on fans and sprinklers, as well as electricity and water costs). It is assumed that no reductions in revenue are associated with cooling cows.

Figure 1 shows daily milk production as a percent of peak production for a hypothetical research-based lactation curve. Using this approach, total milk production over the entire lactation will be a function of peak production. Therefore, increasing peak production will increase daily milk production at each day. For example, a cow that peaks at 100 lb/day will have proportionately higher production every day of her lactation than a cow that peaks at 90 lb/day. Furthermore, because these lactation curves are proportionate, a peak that is 10% lower (e.g., 90 lb/day vs. 100 lb/day) will result in total milk production over the entire lactation that is also 10% lower.

Figure 2 shows the peak milk production by lactation and month for a commercial dairy operation in Kansas with freestall barns but not using any fans or sprinklers for cooling cows. The interpretation of the data in Figure 2 is as follows – the average peak milk production (lb/cow/day) for all cows in their second lactation that peaked in the month of March was 100 lb. Peak production was relatively steady for 7 mo of the year (December through June), but it was less for the other 5 mo, and considerably so in August, September, and October. The reductions in peak production for cows in their second lactation were similar to those in their third or higher lactations on a percentage basis -- about a 13% to 14% difference between highest and lowest peaks. The decrease in first-lactation cows followed a similar seasonal pattern but was considerably less (4% difference between highest and lowest peaks). A logical question then is: How much would it be worth to reduce, or possibly eliminate, the reduction in peak production that occurs in July through November by cooling cows? Using partial budgets and the lactation curve shown in Figure 1, the economic return to reducing the seasonal variation in peak production as displayed in Figure 2 was estimated to answer this question.

Results and Discussion

The dashed lines in Figure 2 represent what the peak production would be if the "gap" between the heat stress months (July through November) and the average of January through June were reduced by 50%. Table 1 shows the returns to reducing the variability in peak production for first, second, and third and higher lactation cows at three "gap reduction" levels. Economic returns are based solely on changes in milk production and do not account for any reproductive or health benefits that might be associated with cooling cows. Production is shown for 1) base peak production levels, i.e., the solid lines in Figure 2; 2) a 25% reduction in the gap between heat stress months and January through June; 3) a 50% reduction in the gap, i.e., the dashed lines in Figure 2; and 4) a 100% reduction in the gap, i.e., the elimination of seasonal variation in peak production. Increased feed costs were based on an additional 0.40 lb of feed for each additional lb of milk. Costs of the cooling system were based on fixed and

variable costs of fans and sprinklers operated for 100 days per year. In addition to returns over feed costs, a benefit/cost ratio was calculated that simply looks at the dollars of revenue that are generated for every dollar of expense. Defined this way, a ratio of less than 1.0 would be unprofitable.

Given that the peak production of first lactation cows was considerably less than that of older cows and very little seasonality occurred in peak production, cooling these cows is not profitable when all costs are included (i.e., benefit/cost ratio <1.0). Completely eliminating the seasonal variation, i.e., a 100% gap reduction, increases total milk production by less than 1%. However, returns over feed costs are positive ($13.11 per cow per year), indicating that this small increase in production is sufficient to pay for the added feed cost.

Cooling second and higher lactation cows at relatively small percentage improvements is economical. The breakeven over total costs is about a 29% reduction in the gap, which represents an increase in total milk production of slightly more than 1% and an increase in the annual average peak production of only 1 lb. If the difference (i.e., gap) in peak production between heat stress months and other months can be reduced by 50% for older cows, the payback is greater than 1.5:1. This compares to a payback of only 27¢ for every dollar spent on cooling first lactation cows at this gap-reduction percentage. This indicates that the profitability of cooling cows will depend on the age distribution of the herd. At a 50% reduction in the gap, a dairy that has an equal distribution of first, second, and third+ lactation cows in the herd would recognize a return of nearly $1.25 for every $1 spent on expenses associated with cooling cows. Furthermore, if the cooling equipment were used only on higher lactation cows, the returns would be about $1.75 for every $1 spent. Thus, given that most dairies have second or higher lactation cows, management strategies that increase peak production by reducing the effects of heat stress most likely will be profitable.

Prices of feed and milk were varied from their initial levels to determine how sensitive returns were to these two factors. Decreasing milk prices from $12/cwt to $11 and $10/cwt resulted in breakeven gap reductions for second and higher lactation cows of 32% and 36%, respectively (initial breakeven was 29%). Increasing feed costs from $120/ton to $150 and $180/ton increased the breakeven percentages to 30% and 33% respectively. Thus, the decision to cool cows is relatively insensitive to both of these factors and especially so to feed prices. This suggests that for high-producing dairy herds, cooling cows over a wide range of feed and milk prices and with relatively small improvements in production most likely will be economical.

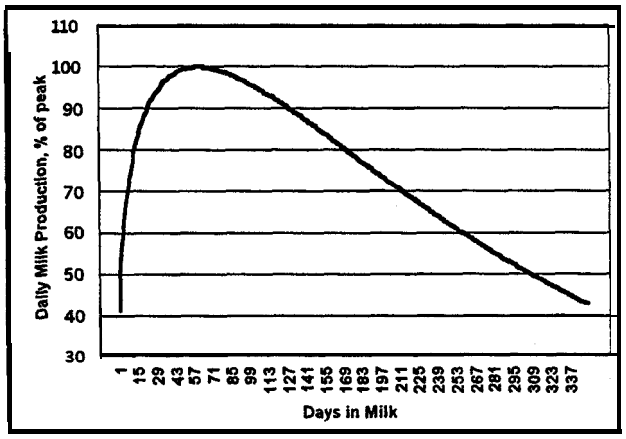

Figure 1. Hypothetical Research-Based Lactation Curve.

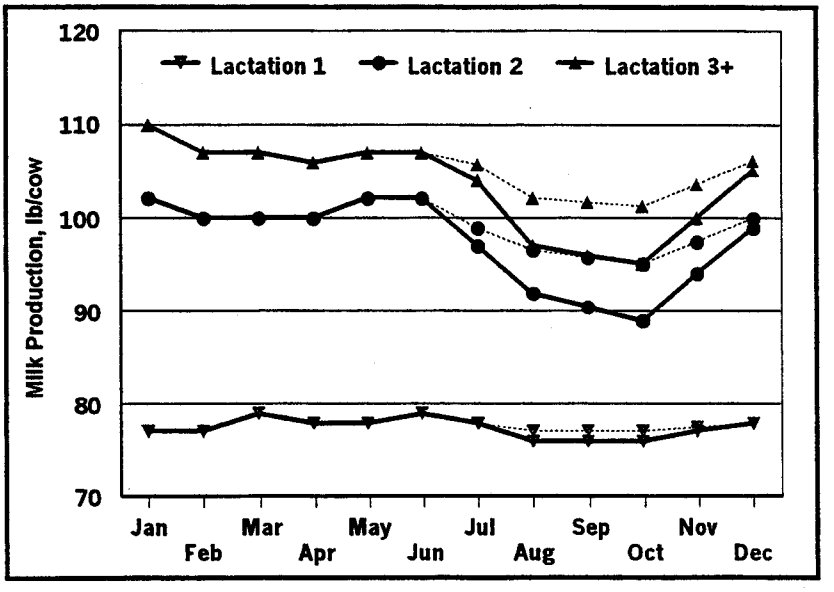

Figure 2. Peak Milk Production by Lactation for a Commercial Dairy in Kansas.

Table 1. Impact of Increasing Peak Production during Heat Stress Months[1]

	Base[2]			25% Reduction in Gap[3]			50% Reduction in Gap[3]			100% Reduction in Gap[3]		
Lactation	L1	L2	L3+	L1	L2	L3+	L1	L2	L3+	L1	L2	L3+
Peak, lb/d[4]	77.4	97.3	103.4	77.6	98.2	104.4	77.7	99.1	105.4	78.0	101.0	107.3
Total, lb[5]	20,354	25,580	27,190	20,392	25,823	27,447	20,431	26,067	27,705	20,507	26,555	28,220
Increase in total from base, %				0.19	0.95	0.95	0.38	1.91	1.89	0.75	3.81	3.79
Per Cow Average:												
Return over feed costs, $/cow/yr[6]				$3.28	$20.83	$22.00	$6.55	$41.66	$44.00	$13.11	$83.33	$88.01
Benefit/cost ratio (income/cost)[7]				0.13	0.85	0.90	0.27	1.70	1.80	0.54	3.41	3.60
Dairy Average:[8]												
Return over feed costs, $/cow/yr[6]				$15.37			$30.74			$61.48		
Total return over feed costs, $/yr[6]				$9,222			$18,444			$36,888		
Benefit/cost ratio (income/cost)[7]				0.63			1.26			2.51		

[1]Heat stress months are assumed to be July through November.

[2]Base represents the production without cooling cows (solid lines in Figure 1).

[3]Gap refers to the difference between peak production in heat stress months and the average for January through June.

[4]Average peak production during the year.

[5]Total production for 350-day lactation (production is annualized by multiplying by 12.0/13.5) – milk at $12.00/cwt.

[6]Feed costs are based on 0.40 lb of feed for each additional lb of milk and $120/ton diet cost.

[7]Cost of cooling system is based on annual cost of fans and sprinklers ($14,680 per year for 100 days of cooling).

[8]Dairy average is based on 600 cows and equal numbers of all three lactations (i.e., 33.3% L1, 33.3% L2, 33.3% L3+).