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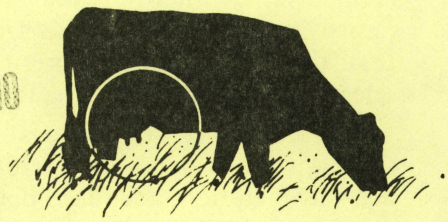

Heritability, Mastitis Incidence and Milk Production

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Most dairymen are painfully aware of the increasing incidence of mastitis as cows progress in age. Table 1 shows California Mastitis Test (CMT) scores summarized from 26,690 records of Holstein cows in Idaho, Oregon and Washington during the years 1972-78 who had at least two records in that period. Only 24.8 percent of the first-calf heifers showed positive while 58.9 percent of the cows in their fifth lactation had positive tests. However, the real question is whether daughters of certain sires consistently have either high or low incidences of CMT scores. Even more importantly, is the incidence of high CMT associated with sire groups having high milk production?

Practical Aspects of Selection

Heritability of many traits in dairy cattle indicate the degree of progress that can be gained by selection. For example, some body characteristics such as mature size may have a fairly high heritability of .5 (on a scale of 0 to 1). This would mean that after standardizing for age and sex, if the selected parents average 1,600 pounds in weight, and the herd average is 1,500 pounds, the offspring should weight 1,550 pounds. Milk production had an overall heritability of approximately .33 for these data. While this is not an extremely high heritability, it is possible to increase production through direct selection. Fat percentage is also moderately heritable at .39.

The chance of obtaining increased genetic merit by direct selection of cows with low CMT scores is minimal. The heritability for CMT score was found to be only .11 for these data. This is not surprising after observing Table 1 where 75.2 percent of the first-calf heifers have identical "negative" scores. Therefore, none of these cows can be separated for genetic merit in disease resistance on the basis of only one record. The only possible way to improve traits with such a low incidence of expression is through the use of pedigree information or progeny testing. Table 2 shows the leucocytes per milliliter of milk corresponding to the coded CMT score from 1 to 5.

Correlated Responses

If the value of trait B can be predicted by knowledge gained by observing a value for trait A, then the two traits are interdependent, or "correlated." Table 1 shows mastitis scores tend to increase as age increases. This suggests that these two traits are positively correlated.

Dairy cattle breeders are interested in genetic correlations. A correlation's importance depends upon how predictable trait B is if trait A were known for specific "families" which may consist of daughters of certain sires.

Table 1. Percentage of cows during their first five lactations receiving different CMT scores.

Mastitis score	Lactation number				
	1	2	3	4	5
Negative	75.2	65.9	56.9	48.6	41.1
Trace	20.7	26.2	31.4	34.8	33.7
1	3.5	6.5	9.3	12.9	17.4
2	.4	1.2	2.1	3.4	6.5
3	.2	.2	.3	.3	1.3

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Table 2. Coding of CMT scores.

CMT score	Coded	Leucocytes/ml
Negative	1	0 - 200,000
Trace	2	150,000 - 500,000
1	3	400,000 - 1,500,000
2	4	800,000 - 5,000,000
3	5	over 5,000,000

Genetic Correlations

A high genetic correlation implies that there are genes in common that influence two traits. Improvement in one trait will result in an added bonus of improvement of the second trait. In general, this results in less improvement than when using selection for improving one trait only.

The Pacific Northwest Holstein cows in the sample studied averaged 15,700 pounds milk in a 305-day lactation. Standard deviation for milk was 2,600 pounds. Butterfat averaged 567 pounds with a standard deviation of 96 pounds. The genetic correlation between milk and butterfat was .7. In this sample, if the dairyman selected parents with 1,000 pounds milk more than the herd average, and since heritability of milk was .33, their daughters would be expected to be 330 pounds superior (.33 × 1,000). The butterfat yield bonus (or correlated response) would be 7.6 pounds.* Conversely, if a dairyman selected solely for butterfat — say a 50 pound superiority — then a 13-pound increase (50 × .26) would be expected along with a 278-pound increase in milk.

Since the genetic correlation between CMT score and milk is only .05, the dairyman who selects 1,000-pound superior parents for milk would only increase coded CMT score by .0024 units. This is based on a CMT standard deviation of .67 units.

Sire Performance on First And Second Recorded Lactations

Examination of daughters of sire groups with two completed records is another method to determine if milk yield and mastitis score are associated. Table 3 shows results of 379 sire groups within 6 regions of the Northwest separated on the basis of high and low milk production for the first and second records of their daughters. If the sire group exceeded the average CMT score, the mastitis incidence was termed "severe."

*D. S. Falconer. *Introduction to Quantitative Genetics.* 1960. The Ronald Press Co., New York. 365 pp.

Table 3. Incidence of daughters with severe CMT scores classified on milk production.

Lactation	Milk production	
	High	Low
First	47%	43%
Last	41%	50%

The incidence of "severe" mastitis actually decreased for the high producers in the second lactation. These data are based on the "survivors" of two lactation records. Whatever method(s) of culling Northwest dairymen are using, the CMT test of high producers is, if anything, being decreased.

Sire Performance In Different Regions

If genetic merit can be easily recognized, daughters of the same sire should rank the same in whatever geographic (or environmental) region they are kept. However, if traits are lowly heritable and/or sire groups react differentially in the various regions (genotype-environmental interaction), then relative rankings of sire groups will be unpredictable from region to region. The average intraclass correlations between sires in the six different regions for the following traits were: milk yield — .37, fat yield — .36, fat percentage — .47 and mastitis score — .19. These results are consistent with what was reported before. In large part, the major factors affecting CMT score are environmental.

The Old-Fashioned Remedy

Selection of sires whose dams, sisters and progeny show high milk yields and low incidence of mastitis would be beneficial only if constant optimum environmental conditions exist for all cows. Maintenance of stable vacuum in the teat cups at levels to milk the cow in 3 to 5 minutes, avoidance of stress to the teat and effective sanitation of the whole system are essential for good performance.

Using chemical disinfectants with disposable paper towels to wash udder and teats, rinsing teat cups between milking, use of the strip cup and monthly CMT screening to isolate and treat acute mastitis cases are all needed to produce quality milk.

No easy way is known to prevent mastitis. The good news is that the present mastitis incidence should not increase with selection of cows with superior ability for high milk production.

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