

DHIA record analysis shows little variation in daily milk and total lactation yield

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DAIRY HERD IMPROVEMENT ASSOCIATION (DHIA) milk production records are estimates of total production based on the production recorded only once each month for each animal. The milk from each milking is weighed on a spring scale and the individual milk weights are summed to obtain a daily total. The daily production is multiplied by the number of days in the month, and the pounds of milk credited for the individual months are then summed to obtain animal lactation totals. These practices have brought up the questions of whether (1) sampling a cow's production once monthly provides an accurate estimate of the total lactation and (2) if DHIA-accepted measuring devices contribute much error to these estimates. The relative impact of a random error on the precision of DHIA records is determined by the magnitude of the existing error variance due to day-to-day variation in yield. This study with Holstein cows was to determine the magnitude of daily variance in dry-lot milk production.

Milk weights for each cow in six 60-cow strings were recorded for 16 consecutive milkings. All data were deleted for any cow found sick at any time, or if a milk weight was missed, or if the metering device was out of order. The metering device failed in 176 cases (about 3.8%), and either no weights or obviously erroneous weights were obtained. Complete information was obtained from 175 cows. The milking barn was a double-4 heringbone in each of two pits equipped with Ross-Holm metering devices.

The average daily milk yield was 39.5 lbs, with an average-within-cow standard deviation of 3.3 lbs. The magnitude of variation as affected by the amount of milk produced daily is shown in table 1. The deviations in yield compared favorably with data collected previously at Cornell University (table 2). This variation includes that resulting from the use of a mechanical metering device, as well as the normal, day-to-day variation in milk yield for a particular cow. The frequency distribution of standard deviations of daily milk weights are illustrated in figure 1. It appears that about 10% of the cows have an average variation of daily yield exceeding 5 lbs. Inspection of individual cow data reveals that these are not necessarily the higher producing cows, since the coefficient of variation (CV) for this group averaged 13%, considerably more than the over-all average.

The impact of existing daily variation on the precision of 305-day lactation production, assuming 10 monthly tests, has been calculated using a statistical procedure reported by J. W. Smith of USDA, a member of the National DHIA "Technical Committee on Weighing, Sampling, and Testing Devices." Considering an average standard deviation (variation) in daily milk yield of 3.3 lbs, the expected variation in the calculated total lactation yield would be 320 lbs of milk—if the average cow produces 13,420 lbs of milk in a 305-day lactation. This means that about 67% of the DHIA estimated records would be expected to be within 320 lbs of the actual record, and about 95% of the estimated records would be within 640 lbs (or 4.8%) of the actual record.

The second question to be answered relates to the amount of variation added to the estimated 305-day DHIA records, when approved sampling devices are used. The statistical proof necessary to answer this question is too lengthy and complicated to be illustrated here. Smith has shown that sampling devices are acceptable when 95% of the individual milkings are within 5% of the true weight and have minimal bias. When sampling devices meet these criteria, their use has a relatively minor impact on the precision of the lactation estimate. Normal day-to-day variation in milk yield is a random error which controls precision (repeatability), while a systematic error such as bias, controls accuracy (deviation from the true lactation total). In effect, if a recording machine is biased, then the error is directional, and the precision must necessarily be increased.

Depending on the amount of total variation due to bias (from 1 to 25%), it can be shown that only 9 to 34 lbs would be added to the variation found in the typical 13,420-pound record cited earlier. This means that 95% of the DHIA-estimated records would be within 622 pounds (or 4.6%) of the weight if collected in a bucket or weigh jar.

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TABLE 1. WITHIN-COW VARIATION IN DAILY MILK YIELD

Milk production	Number of cows	Average Milk		
		lbs	σ	C.V.
(total = 175)				
		39.5	3.3	8.7
0-35 lbs	69	26.2	2.6	10.1
35-45 lbs	52	39.6	3.3	8.3
45-60 lbs	39	51.4	3.7	7.1
60-100 lbs	15	69.4	5.1	7.3

TABLE 2. COMPARISON OF CALIFORNIA AND NEW YORK DATA ON VARIATION IN DAILY MILK YIELD

California		New York	
	σ		σ
Average	3.3	Average	3.45
30-lb producers	2.6	2-year-olds	2.68
40-lb producers	3.3	3-year-olds	3.37
50-lb producers	3.7	4-year-olds	3.81
70-lb producers	5.1	5- to 8-year-olds	4.05

FIGURE 1. DISTRIBUTION OF STANDARD DEVIATIONS OF DAILY MILK WEIGHTS

