Multiple Paths to Maximum Milk Production in Dairy Herds

Mark L. Kinsel[a], **William E. Marsh**[a]
Jeffrey K. Reneau[b]
[a]*Department of Clinical Population Sciences*
College of Veterinary Medicine
[b]*Department of Animal Science*
College of Agriculture
University of Minnesota, St. Paul, MN 55108

Abstract

Substantial effort has been invested in research strategies to maximize milk production on dairy farms. Nearly all of these approaches have focused on reaching target performance levels for the key components of milk production (milk per cow per day, calving interval, culling rate, etc.). Significant deviations from these targets have been viewed as suboptimal performance and a "problem" to correct through improved management.

However, research in our laboratory using large swine databases has shown that setting targets without regard to the underlying biological and mathematical relationships among performance parameters is imprudent. It inevitably results in a biologically impossible combination of values being set as targets.

In this study, we use production data from 152 dairy herds. We will describe the range of performance for the components of the milk production cycle that were achieved by the highest producing dairy herds in our database. These findings can be used by all dairy producers to set production targets for commonly used productivity measures that are biologically consistent with one another.

Substantial effort has been invested in research strategies to maximize milk production on dairy farms. Nearly all of these approaches have focused on reaching target performance levels for the key components of milk production (milk per cow per day, calving interval, culling rate, etc.). Significant deviations from these targets have been viewed as suboptimal performance and a "problem" to correct through improved management. However, research in our laboratory using large swine databases has shown that setting targets without regard to the underlying biological and mathematical relationships among performance parameters is imprudent. It inevitably results in a biologically impossible combination of values being set as targets (Marsh, 1992). Similar research involving 87 dairy herds (Lemire *et al.*, 1991) concluded that it was important to derive performance parameters from a population of herds of similar size and management characteristics rather than blindly accept values published in the literature. The goal of the current study was to describe the range of performance that was experienced by high (and low) producing dairy herds for the key components of the milk production cycle.

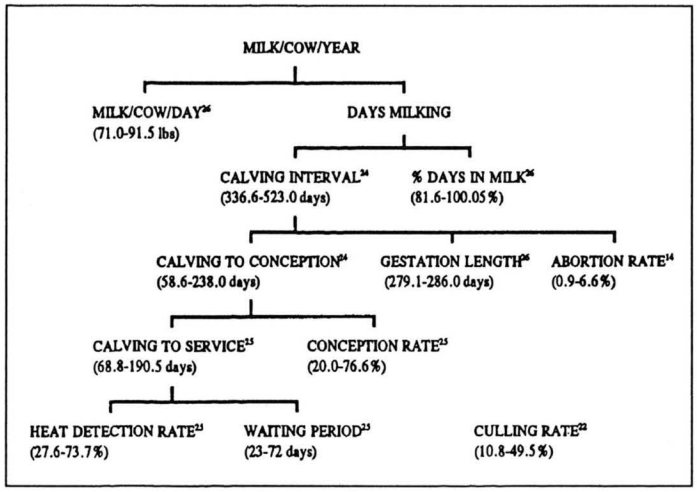
Materials and Methods

Data for this study was derived from records for 152 farms using the DairyCHAMP herd management software developed at the University of Minnesota. Performance measures computed in the DairyCHAMP Periodic Report subroutine were calculated for each of three 12 month periods; July 1989-June 1990, July 1990-June 1991, and July 1990-June 1992, and the data was then written to an ASCII file. This ASCII file was uploaded into the Statistix 4.0 software for analysis with each farm-year representing a row of data. Average milk production per cow per day was ranked for the 261 farm-years in which production records were kept and the top and bottom 10% (26 farm-years) were evaluated based on nine components of milk produced per cow per year. These nine performance measures were: waiting period (the minimum number of days from calving until the first breeding), heat detection rate, culling rate, average calving to first service interval, conception rate, average calving to conception interval, abortion rate, average calving to calving interval and the average proportion of the year spent milking. The range of values were calculated for only the farm-years that recorded sufficient data to generate the statistic.

Results

Milk production per cow per day for the top 26 farm-years exceeded 71.5 pounds while production in the bottom 26 farm-years was below 47.1 pounds. A productivity tree showing the range in performance for the top 26 farm-years is shown in Figure 1.

Figure 1. Productivity tree for milk per cow per year. Values in parenthesis represent range for 26 farm-years over 90th percentile for milk production. Superscript values represent number of farm-years used to calculate range.



A comparison of the performance of the top and bottom 26 farm-years are presented in the following table:

PERFORMANCE MEASURE	TOP 10%*	BOTTOM 10%*	p
Heat detection rate (%)	52.9 ± 2.3^{24}	45.2 ± 3.1^{21}	0.051
Calving to service (days)	95.8 ± 5.5^{25}	92.6 ± 3.7^{22}	0.635
Calving to conception (days)	119.5 ± 6.9^{25}	141.9 ± 8.3^{22}	0.043
Conception rate (%)	43.4 ± 3.3^{25}	40.1 ± 4.3^{22}	0.540
Observed abortion rate (%)	2.3 ± 0.4^{14}	3.2 ± 0.4^{19}	0.096
Percent days in milk (%)	90.2 ± 1.2^{26}	84.0 ± 1.6^{26}	0.013
Culling rate (%)	24.1 ± 2.5^{22}	20.0 ± 1.8^{23}	0.179

*Values are mean ± standard error, superscript indicates number of farm-years included.

Discussion

Findings of this study suggest that, although high producing dairies had better performance in general, a wide range of values exist for current measures of biological performance in high (and low) producing dairies. This result has several interesting implications. First, it appears that numerous pathways exist to achieve high levels of milk production and that no dairy reached maximum productivity in all areas of performance. This may be due to an underlying requirement for a biologically impossible combination of events and suggests that attempts to maximize all areas of performance without respect to underlying dairy goals and management style is imprudent.

Second, the wide range of performance for high producing herds may indicate that some or all of the currently used performance parameters do not reflect important determinants for maximizing milk production. Nearly all of the current performance measures are based on mean performance with little attention to the performance distributions. This use of averages focuses the dairy manager's attention on "normal" animals (animals which are near the mean) when the animals that will most likely influence performance are those with abnormal values (extreme cases in the distribution). A second problem is the different time frame of current performance parameters. For example, calving to calving interval reflects reproductive performance 9 to 24 months previously while calving to conception interval reflects reproductive performance 2 to 9 months previously (Upham, 1991). Therefore, there is a need to rethink our approach to determining the factors to evaluate in assessing management efforts to maximize milk production.

Finally, it is important to note that efforts to maximize milk production do not necessarily maximize dairy profitability. Financial data was not available for the study farms at the time of analysis. Ultimately, management efforts should be aimed at maximizing profitability which will require efforts to maximize productivity per unit cost. Additional experiments are currently being initiated to investigate similar relationships between biological performance and dairy profitability.

References

Lemire, G.E., Stalheim, P.S., Lemire, M.R., Verdon, L., Tiemann, M., and Bruning, T.R., 1991. Monitoring reproductive performance of small dairy herds in veterinary practice. *Can. Vet. J.*, 32:551-557. Marsh, W.E., 1992. Meaningful measures of herd productivity: Setting targets that make biological sense. Proc. Am. Assoc. Swine Prac. Annual Mtg. Nashville. March 1-3, 1992. Upham, G.L., 1991. Measuring dairy herd reproductive performance. *Bov. Prac.*, 26: 49-56.