Evaluating Herd Reproductive Status

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Introduction

The realization that herd reproductive performance limits herd production and profits has made reproductive herd health programs increasingly popular with dairy clients for the last 25 years. We must ensure that reproductive health programs continue to contribute to farm profits. To do this we must continually measure and monitor herd reproductive performance. Many indices of reproductive performance have been described, so it may be difficult and confusing to decide which indices to use and how to use them.

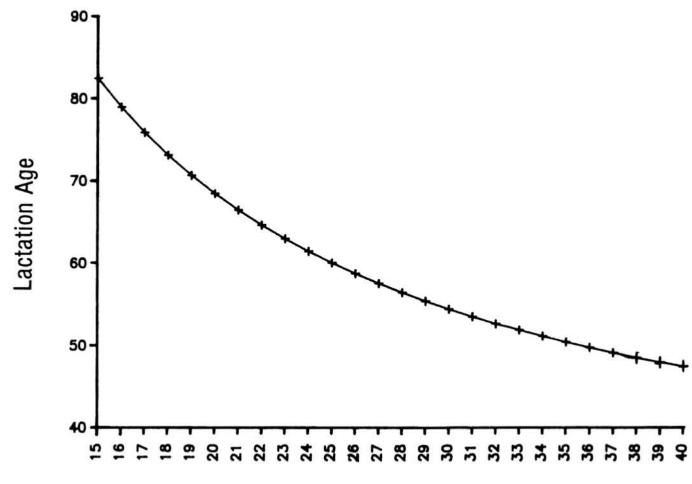
This paper describes relationships between reproductive performance, production and farm incomes. It considers some indices of reproduction and how they are used to monitor herd reproductive performance to keep it profitable. To provide a benchmark for normal values of these indices, average 1984/5 indices for 21 typical Minnesota and Wisconsin herds are presented. These herds had used the DairyCHAMP Computerized Health and Management Program for a sufficient time to allow a correct analysis in 1986.

Reproduction, Production and Profit

Dairy enterprises produce 2 products: milk and livestock. A number of studies have shown that short calving intervals of around 12 months are associated with highest lifetime milk production levels (1,2,3). When heifer production performance is included the desirable mean calving intervals are extended to over 12 months because of their greater persistency. However shorter calving intervals do not only have this direct effect on production. Indirect reproductive effects on production also have significant economic impacts. We realize that as the calving interval is reduced the number of calves born increases (4). Thus the number of replacement heifers available to the herd increases as does the number of bull calves for sale.

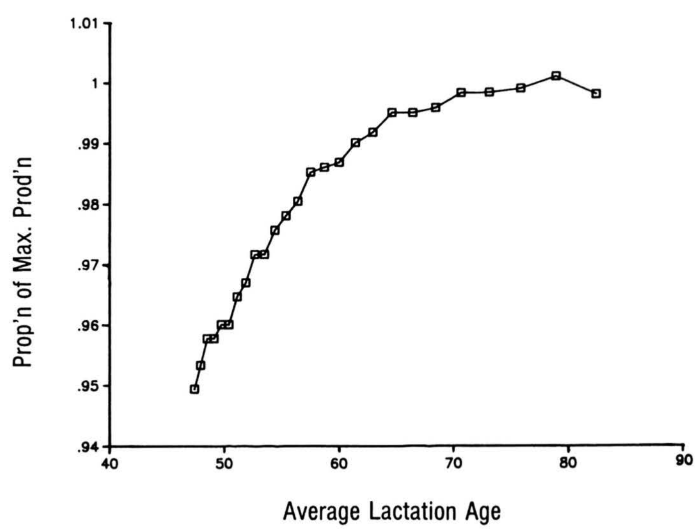
Improved reproductive efficiency is associated with reduced reproductive culling as well as decreased calving intervals. When the amount of reproductive culling declines, the overall culling rate will also decline if all else is constant. As culling rate declines, average herd age increases. Figure 1 illustrated the relationship between culling rate and average herd age which appears to be appropriate for Minnesota herds. We also know that production level and efficiency of cows improve with age up to the 6th or 7th lactation. The standard Dairy Herd Improvement Association correction factors from USDA can be used to predict the impact of changing herd age on the potential herd production. Figure 2 illustrates the relationship between age and the proportion of potential mature production for Minnesota herds taken from Norman et al. 1974 (5).

FIGURE 1. Herd Cull Rate v AV. Lact'n Age.



The author has previously utilized these relationships in a partial budget to illustrate the impact of a reproductive health program on herd profitability (6). The budget has also been developed by the author as a Supercalc 3 template to

FIGURE 2. Prop'n of Max Prod'n v Lact'n Age.



allow ready calculation of the impact of changes in production related indices of reproduction on herd profits. This has been found to be extremely useful in demonstrating to farmers the financial impacts and benefits to them of their participation in reproductive health programs.

The performance of a typical Minnesota herd which participates in our DairyCHAMP reproductive program is illustrated and compared with the average performance of Minnesota DHIA herds in Table 1. Some implications of the reproductive performance differences shown in Table 1 are illustrated in the livestock inventory Table 2. A budget of the financial implications of the observed differences is presented as Table 3. The important things to note from the budget are the relatively high contributions to production and income of the increase in herd age achieved by decreasing herd culling and the major contribution to income of the value of additional heifers raised and not required as replacements. The additional heifers for sale result from increased births and lower culling and therefore need for replacements.

We can conclude from the above that calving to calving interval and culling rate (especially reproductive culling rate) are critical production related indices of reproductive performance. They should always be looked at together when evaluating herd reproductive performance since indices of calving interval appear acceptable can be obtained by simply culling all cows with long intervals. Another consideration is that some cows are retained in herds for prolonged periods without a calving occurring. For example, a cow may calve in November of 1984 and not again until June of 1986. In an analysis of cows calving in 1985, the performance of this cow will not be included. The impact of such cows on herd economics needs investigation.

Indices of Herd Reproductive Performance

Production Related Indices

As the foregoing discussion illustrates, calving interval and culling rate are two production-related indices of reproductive performance. However, calving interval is not desirable as an index for monitoring herd reproductive performance because it is too retrospective (since in the way it is normally calculated it measures the time from a previous calving to that of a recent calving). Thus the index really measures the reproductive performance of a herd in the breeding period before the cow's most recent gestation. If improvements are occurring in herd reproductive performance, they may not show up in this index for 12 months or more. The index may also be biased by the exclusion of those cows which do not re-calve due to abortions or sale (7). These are generally the poorer performing cows.

Calving to conception interval can be used in place of the calving to calving interval because it measures essentially the same processes but is available much sooner (8). As well as being more contemporary, it is less subject to the bias of cows being culled because of late conception and never having a calving interval. The mean calving to conception interval for the 21 DairyCHAMP herds was 107 days with a range of from 91.2 to 137.1 days. The median calving to conception intervals are possibly more representative of true herd performance because they are not biased by the non-normal nature of the skewness of the distribution. Cows with

TABLE 1. A Comparison of Performance-Related Indices in Minnesota Average DHIA and Average DairyCHAMP Herds.

Characteristic	**Average DHIA**	**Average CHAMP**
Observed		
Herd Size (cows)	56	56
Calving to Conception Interval (days)	126	107
Cull Cows	19	15.5

TABLE 2. A Livestock Inventory Resulting from Reproductive Performance Differences of Minnesota DHIA and DairyCHAMP Herds.

Livestock Characteristic	**Average DHIA**	**Average CHAMP**
Calves born per year	50	53
Males born per year	25	26.5
Females born per year	25	26.5
Calves died	4	4
Bull calves for sale	23	24
Females raised	24	25
Heifers available per year	21	22
Heifer replacements required	19	15.5
Heifers to sell	1	6

TABLE 3. Budgeted Returns from Improved Reproduction.

Additional Returns		**Value $**
Increased Milk Production dt Calv Int.	17252 lb	
Increased Milk Production dt Av. Cow Age	19430 lb	4218.47
In Calf Heifers Sold	4	4037.19
Bull Calves Sold	1	101.30
Total Extra Returns		8356.97
Costs No Longer Incurred		
Semen Costs	0	.00
Shorter Heifer Raising Time (days saved)	0	.00
Total Decreased Costs		.00
Additional Costs		
Total Increased Veterinary Costs		840
Extra Feed for Extra Production		1067.14
Costs of Raising Extra Heifers (days added)	828	1589.85
Total Added Costs		3496.99
Returns No Longer Obtained		
Decreased Cull Cow Sales	3.5	1575
Total Returns No Longer Obtained		1575
Net Return From Improvement		3284.97
Net Return per Cow		58.66

very long intervals don't raise the average so much. The average of the medians of calving to conception intervals was 99.8 days. Deal mean calving to conception intervals are 83 to 85 days for individual cows and about 90 days for herds due to the skewness of the distribution.

The *proportion of a herd calving* in a year averaged 109.6% of the average herd size with a range from 72.1% to 126.9%. This index is influenced by the number of heifers calving into a herd and also the number of cows which calve twice in a year. Some cows in a herd will not calve in the year for which performance is being analysed. The *proportion of the herd not calving in a year* averaged 10.2% with a range from 0% to 24.9%. Since the performance of these cows is not included in the analysis of annual performance, its absence may represent a major source of bias in the annual reproductive indices of some herds. A realistic target for the proportion of cows which don't calve in a year is less than 10%, since this was the average achieved in the DairyCHAMP herds.

Culling rate is readily calculated as the number of cows culled as a proportion of average herd size for any time period. Culling rate for the herds varied widely from 15.3% to 51.2% of the average herd size. The average culling rate for the herds was 27.7% of the mean herd size.

Calving (or calving to conception intervals), the proportion of the herd calving and culling rates reflect the final outcome of all of the factors influencing herd fertility. While they relate to productivity they do not aid in the identification of problems causing inadequate reproductive performance.

Diagnostic Indices of Herd Reproductive Performance

To document performance and identify problems beyond the level of excessive calving interval or excessive culling, other indices can be derived from herd records if adequate information is available. It is important to clearly define the population to be analyzed in producing indices of performance so that consistency and comparability can be achieved. To some extent the populations may vary depending on whether the analysis is a monitor of recent performance or a long term evaluation of progress.

In monitoring, it is important to get a picture of what has been happening recently in a herd. Thus an index may relate only to the events occurring in the last month, (e.g. pregnancy diagnoses in the last months), rather than all events for a year. This makes the measure current and reflective of recent performance, where an annual rolling average can (for example) mask a seasonal trend in an index and be much less sensitive in showing adverse changes in performance.

When the object of the reproductive analysis is to document the performance for a herd to be used as a basis of comparison between years or a basis for comparison between herds, the population to be used should include all cows which calve in a year and meet the criteria for analysis.

The *calving to first service interval* separates pre-breeding from post-breeding factors influencing reproductive efficiency, and so is a useful starting point in the process of narrowing down causes of low reproductive performance. It depends on the occurrence and observation of estrus, the maintenance of records and the farmer's policy regarding breeding cows at observed heats. If calving to service intervals are short, (65 day herd average or less) the occurrence, observation and recording of estrus and the breeding management policy are compatible with efficient reproduction. If a fertility problem exists attention can be concentrated on factors operating at or after breeding. Long intervals to breeding indicate that the occurrence, observation and recording of estrus need to be investigated. The mean interval to first breeding in 21 DairyCHAMP herds was 79.9 days (range 68.2 to 113.0) and the median interval was 75.1 days.

Estrus detection may influence the calving to service interval considerably. An index of the observation of estrus is the *estrus detection rate,* defined as [(21 / average interestral interval) x 100] (9). The target level of performance for this index is 85%. The mean estrus detection rate for DairyCHAMP herds was 64.6% with a range from 46.9% to 85.4%. Another measure of estrus detection is the *ratio of single to double interestral cycle lengths* (10).

A measure of both the occurrence *and* detection of estrus is the *proportion of cows in heat by 60 days after calving.* A failure to cycle due to inadequate nutritional management is frequently observed as a number of cows with poor body condition and inactive ovaries. The mean proportion of cows with recorded heats in the CHAMP herds was only 48.3% of cows (range 11.1% to 87.5%). The low mean and wide range is largely due to a failure to record heats in the early post-partum period. Where pre-breeding heats are not recorded, many cows are examined unnecessarily at a cost to farmers. Recording of pre-breeding heats helps to establish whether normal cycling is occurring without the expense to the farmer of veterinary palpation.

The influence of a farmer's decision to delay breeding can be measured and documented as the mean interval from a heat detected at a time when service is reasonable (>50 days postpartum) until service is given. This delay is due to policy and is called *deferral interval* by the author. It can contribute significantly to calving interval in some herds and is due entirely to management policy. It occurred in 11.8% of calving intervals in CHAMP herds. The mean length of deferral was 27.9 days which contributed 4.6 days to the calving intervals of these herds. This is the saving that could be made in calving interval by convincing farmers to breed at every heat beyond 50 days which they already detect and note.

Satisfactory intervals to service with long intervals to conception indicate that there are conception problems or a failure to re-breed previously bred cows. A low *proportion of cows pregnant at pregnancy diagnosis,* where cows are normal and cycling on examination, indicates estrus detection problems after breeding (11). The 21 CHAMP herds had 72.9% of cows pregnant at pregnancy diagnosis. A suitable target level is over 85%.

Conception rate (or really *diagnosed pregnancy rate*) measures the outcome of breedings. It is influenced by cow factors like disease, conformation and nutritional status. Nutritional inadequacies are generally associated with low production and excessive bodyweight changes. Infections may be involved and histories should be checked regarding calving hygiene, diagnosed uterine infections or vaginal discharges and vaccination status. Analysis of conception status by group and age may help to define problems and guide diagnostic efforts. Low conception rates in association with anestrus in early post-partum cows constitute strong evidence of nutritional inadequacy.

Bull factors include the variation in fertility which occurs between different sires and between inseminators. Other bull factors are semen handling variations, artificial breeding technique and semen batch. Low conception rate associated with 1 or 2 of these variables indicates a problem due to this factor. First service conception rate provides the least biased estimation of bull factors. Overall conception rates can be biased due to a large number of unsuccessful services being given to a few cows. This may make conception rates look low, but have little impact on overall herd reproductive efficiency. This possible bias is avoided when first service conception rates are used.

The interval from calving to service (12) and the interval from heat detection to breeding are 2 management factors which influence conception rate. Sometimes farmers complain of conception rate problems in their herds which can be solely explained on the basis of early breeding after calving. Environmental factors also influence fertility. The results of a recent Minnesota study (P. Udomprasert and N.B. Williamson, Unpublished) indicate that fertility is depressed when high or low ambient temperatures occur. The major depression of fertility occurred in August in Minnesota which is the hottest month. Lack of environmental cleanliness may have significant effect on reproductive efficiency, by allowing uterine infection to occur and thus delaying cycling as well as depressing conception rates. The first service conception rate was 45.8% in the CHAMP herds with the range being from 17.2% to 66.7%. Conception rate to all subsequent services was 43.1%.

The number of *services per conception* required for cows which conceive is also a measure of fertility. The range in number of services required for conception in the DairyCHAMP herds was from 1.4 to 3.0 with a mean of 2.0.

The *age at first calving* for heifers which enter the milking herd is another reproductive index which is related to production efficiency and profit. The ideal age at first calving is commonly accepted as being 24 months. A delayed first calving depresses the reproductive efficiency of a herd. With proper monitoring, and a health management program approach we have shown by preliminary analysis of a current study that in Minnesota we can reduce the age at first calving of heifers by over a month and increase production efficiency and profits.

A final index of reproductive efficiency which is a useful diagnostic indicator is the *pregnancy loss rate*. This is the proportion of the herd which is found to be pregnant and then found to be non-pregnant at a usbsequent examination before the expected calving. Keeping this information and monitoring the index may reveal a subclinical problem of prenatal death that may otherwise go undetected by a farmer. The pregnancy loss rate in the DairyCHAMP herds ranged from 0% for 6 to a high of 19.1% in one small herd. The mean pregnancy loss rate was 6.1%. The proportion of abortions occurring at less than 4 months was 66%, between 4 and 7 months it was 17% and beyond 7 months, again 17%.

Conclusion

Reproduction in dairy cows is related to production efficiency and farm economic performance in several ways. A few indices of performance can reflect the economically important aspects of reproduction in dairy cows. Performance targets can be set and compared to observed indices. When performance in economically related indices falls below accepted target levels, diagnostic indices of performance can then be used to indicate which management functions and reproductive processes need to be improved.

An evaluation of herd reproductive performance and status requires a planned and systematic consideration of indices which reflect key components in the reproductive process. Indices reflecting the occurrence of estrus, its observation, whether or not cows are bred at estrus, and the outcome of breeding are all available. A comparison of these with expected performance levels can indicate where deficiencies occur and where opportunities for improvement exist.

The average performance levels for many of the key reproductive indices in 21 dairy herds are reported here so that practitioners may have a basis for comparison when evaluating performance in herds which they visit.

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Abstracts

Effects of long acting and short acting oestradiol implants on growth rate and carcase weight of steers

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Veterinary Record (1986) **119**, 427-429

The effects of a number of steroid hormone treatments on growth were examined in a trial involving 204 Friesian-type steers which was carried out over an 11 month period from May to April. The animals were at pasture from May until October and were over-wintered indoors on grass silage and supplementary concentrates. Thirty-four animals were used as untreated controls, and there were four treatment groups: (1) 43 steers were implanted with pellet-type implants containing 20 mg oestradiol benzoate and 200 mg progesterone on days 1, 105 and 187; (2) 47 steers were implanted with a single silastic rubber implant containing 45 mg oestradiol-17β; (3) 36 steers received treatment (1) and in addition were implanted on the same days with 300 mg trenbolone acetate; (4) 44 steers received treatment (2) and were also implanted with 300 mg trenbolone acetate on days 1, 105 and 187. The mean liveweight gains (± sem) of the steers during the first 249 days of the trial were 201·7 kg for the controls and 236·8, 219·4, 254·4 and 247·8 (±6·1) kg for the steers assigned to treatments 1, 2, 3 and 4, respectively. The corresponding values for the carcase weights (± sem) were 300·0 kg for the controls and 318·4, 312·0, 327·9 and 321·6 (± 3·5) kg for the treated groups. Although all the treatments increased the liveweight gains and carcase weights significantly compared with the controls, the responses to the silastic rubber implants were smaller owing primarily to an apparently high rate of loss of the implants. Implantation with trenbolone acetate in conjunction with oestradiol yielded a significant additional response in terms of liveweight gain and carcase weight.

Early season parasitic gastroenteritis in calves and its prevention with ivermectin

D. E. Jacobs, M. T. Fox, W. G. Ryan

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In a two-year trial involving successive batches of 36 autumn-born steers on two adjacent sites in Hertfordshire, calves treated with ivermectin at three and eight weeks after turn out contaminated pastures much less than untreated control animals. Each year dry summers prevented the larval challenge on the control pastures from building up to high levels until about the time of autumn housing. Atypical outbreaks of parasitic gastroenteritis were recorded in May and June of the second year in both groups of control calves. Clinical and parasitological aspects of these outbreaks are discussed in the context of the epidemiology of the disease. It is concluded that the application of measures to control gastroenteritis can bring benefits in the early part of the grazing season as well as later in the year.