Breeding for female fertility
- current status and future possibilities in Norway

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Abstract

Fertility is of great importance in milk production system and might be measured in many different ways. Estimates for heritabilities of female fertility traits are low but the additive genetic variation are large. In Norway, evaluation of Norwegian Cattle (NRF) sires for daughter fertility has been done since 1974.

This evaluation is based on non-return rate at 60 days of heifers in a sire model and the progeny group size is about 300. Data from 1978 available to genetic studies of fertility traits, and it is important estimate the genetic gain for fertility traits in NRF.

1. Introduction

Fertility is important to the economy of dairy cattle production and fertility problems increase the calving interval, insemination and veterinary costs and result in a higher culling rate. In Norway poor fertility, after management reasons, is the most important reason for culling in the first parity. In 1996, 14.2 percent of all culling of dairy cows in the first parity were due to fertility problems (NML, 1997). The economic value increases when the fertility level decreases . For example, Refsdal (1980) estimated the loss to be NOK 8.2 mill. per percent reduction in the calving rate when the rate of calves after inseminations is between 50 and 60 percent.

There are different methods that can be used to measure female fertility in dairy cows. Non-return rate at 56 or 60 days for heifers and cows, days from calving to first or last insemination, number of inseminations per service period and calving interval are the most common measures of female fertility. Evaluation of sires for daughter fertility is often based on non-return rate of heifers or non-return for first parity cows or a combination of non-return and other fertility traits in first parity. There are, however, some problems connected with the fertility traits from first parity and later parities. First of all, culling decision are often based on fertility traits. Therefore, data used in the progeny test may be selected, and the probability of being culled is lower for cows with a high milk yield.

Heritabilities of female fertility, reported by Jansen (1986) and Weller and Ron (1992), varied from 0.01 to 0.05. Even if the heritability is low, the additive genetic variation is considerable (Philipsson, 1981; Hermas, 1987). This is most likely due to a high phenotypic variation and a large environmental impact on the fertility traits. Low heritablity requires large progeny groups in order to obtain an acceptable accuracy on the breeding value. In Norway evaluation of sires for daughter fertility has been carried out since 1974.

2. Breeding for fertility in Norway

In Norway, about 310,000 dairy cows belongs to the Norwegian Cattle population (NRF). In this population, fertility is an important trait in the breeding objective. The inseminations are reported by technicians and veterinarians into a semen database. From that database, non-return rate at 60 days for heifers are derived, and this is the measure used in the breeding value of fertility. The reasons for using heifer information are to avoid selection and also that the accuracy can only be marginally improved by including later available information.

The estimation of breeding values for fertility is based on a BLUP sire model, and the last batch of tested bulls are included in the evaluation. When this method of progeny testing for fertility was developed, there was found large differences between inseminators and, therefore, the only fixed effect in the model is the interaction of inseminator and month of first insemination (Fimland, 1984). Number of daughters per bull are around 300, and the correlation between true and estimated breeding value is close to 0.75.

Today, 11 traits are included in the total merit index of the NRF bulls. This index is the selection criteria for the bulls, and the breeding value of fertility is weighted into the total merit index together with the other traits. Table 1 shows the relative weights on different traits in the total merit index in NRF.

Table 1. Traits and relative weights in the total merit index in NRF breeding program. (Steine, 1997)

Traits	Weights in percent
Protein kg	21
Beef	12
Body	2
Legs	4
Udder	11
Temperament	4
Fertility	**14**
Stillbirth	4
Calving difficulties	4
Mastitis resistance	21
Other diseases	3

Actually, the relative weight on fertility in the total merit index has increased from 5 percent in 1974 to 14 percent in 1997. Today, only milk and mastitis, with weights of 21 percent each, have a higher relative weight than fertility in the total merit index.

The sperm quality has a direct effect on the result of the insemination.

However, the male fertility has so far not been included in progeny testing. Solbu (1984) has pointed out the following reasons for this:

- Ejaculates that is not fulfilling special quality requirement are discarded.
- Bulls with many bad microscopic ejaculates, low libido or with low non-return rate from test inseminations are slaughtered and not later used in A.I.

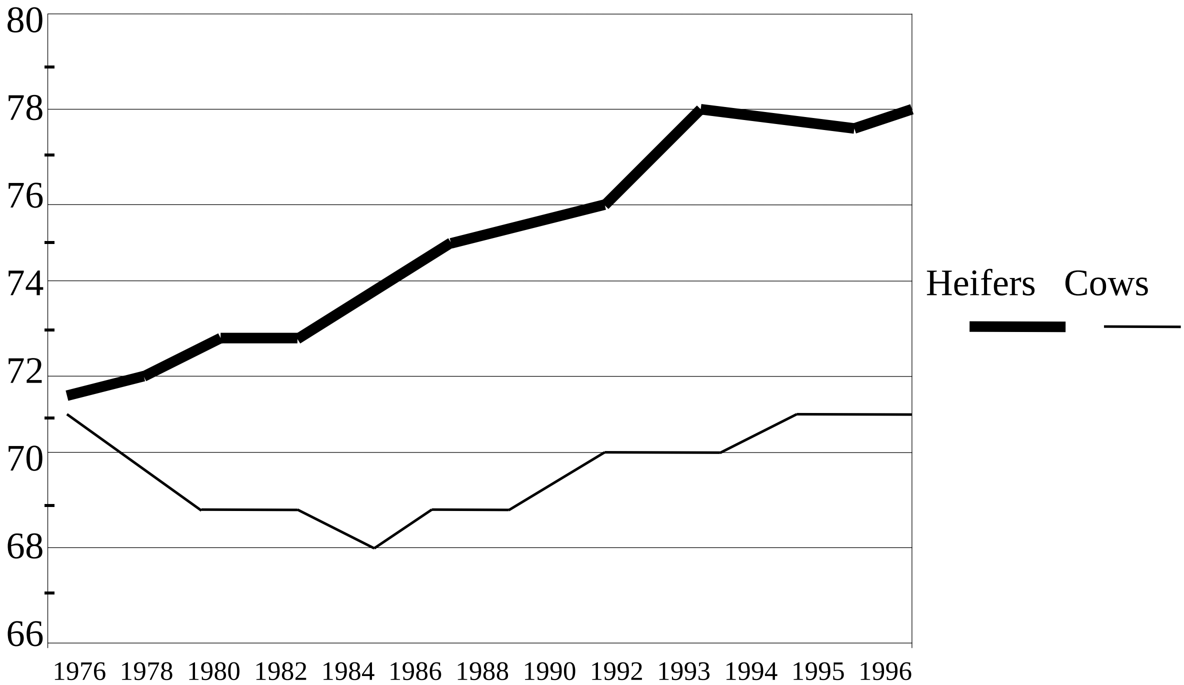

Figure 1. Non-return at 60 days in NRF population (Refsdal, 1997) .

Phenotypic fertility of heifers, measured as non-return rate at 60 days, has improved over the last twenty years as shown in fig. 1. The progress may be due to better environment in the herds, but selection for fertility have probably improved the genetic level of the heifers non-return at 60 days.

Non-return rate at 60 days for cows has decreased from 71% in 1979 to 68% in 1984 and was again 71% in 1996. It is difficult to distinguish between the genetic and environment reasons behind changes in the non-return rate of cows. There are, actually, two factors that may have change the phenotypic fertility of milking cows:

- Changes in relative weights between different traits in the total merit index.
- The fact that in the last decade 19 percent of milk producers (NML, 1997) have given up milk production. These farmers were probably those that were the less interested and capable in milk production.

3. Estimation of genetic parameters for fertility in Norwegian cattle

Data from the insemination recording is transferred and stored in the national milk recording system. Today, data from 1978 is available, and this information will be used to analyse the fertility traits. This field data has a high quality and information on many different traits may be derived. Close to 90 percent of the Norwegian cows is taking part in the milk recording system.

The following traits seems to be the most interesting for genetic studies:

- non-return rate at 60 days for heifers and first parity cows
- number of inseminations per service period and days from first insemination to last insemination for heifers and first parity cows
- days from calving to first insemination/last insemination for first parity cows

In addition to estimating the parameters for these traits, we have to estimate their internal correlations and over lactations and also between fertility and other traits in the breeding objective.

Since only non-return rate at 60 days for virgin heifers is used in breeding value estimation in the NRF, it is especially important to estimate the correlations between this trait and other fertility traits in first and later parities. Estimates about correlations between heifers and cows fertility are very variable. Janson (1980) has found that heifer and cow fertility were closely correlated, and that genetic correlation between non-return rate at 56 days for heifers and cows in first parity was close to 1. Janson concluded that selection for improved fertility could be based on heifers fertility. Other researchers have approximately found no genetic association between fertility of heifers and cows (Raheja et al., 1989; Hansen et al.,1983a).

Under Norwegian conditions, it also important to estimate the genetic correlation between fertility and other traits in the breeding objective. Until 1997 milk production has been the most important trait in the Norwegian breeding objective and several researchers have estimated a genetic antagonism between milk yield and different fertility traits (Janson and Andreasson, 1981; Hansen et al., 1983b; Lyons and Freeman, 1991; Oltenacu, 1990; Hoekstra et al.,1994; Weller and Ezra, 1997). Long term selection for milk yield, only, should therefore result in a decreased genetic level of fertility. In the period 1975 to 1996, milk production per cow increased from 5428 to 6265 kilo milk per year, (NML,1997). The genetic progress for milk yield was 70-80 kilo milk per year over the last decade.

NRF is a co-operative organisation and the farmers decide which traits included, and their relative weighting in the breeding objective. To maintain interest for fertility and other non-production traits, it is important to document an eventual genetic progress in these traits. During the last 10 years, fertility has been given a considerable weight in the Norwegian breeding objective, and we should expect a genetic gain in heifers non-return rate. As today's estimate of genetic trend is based on realised selection differential it is important to carry out a more detailed investigation of the genetic trend of fertility in NRF population.

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