

# Genetic evaluation for fertility in French dairy cattle

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## Abstract

In the French fertility evaluation, the analyzed trait is defined as the result (success/failure) of each artificial insemination. This measure may be ascertained when subsequent calving is known, or is only the most likely otherwise. This all-or-none measure is used to evaluate both male and female fertility. However, only female fertility is considered as a genetic effect. A linear model is defined, including the fixed effects of herd-year, technician-year, month-year-region, parity-year-region, calving-insemination interval, week day-year-region, breed of service sire, and the random effects of cow, service sire, sire and maternal grand-sire of the cow. Data include about 15 million artificial inseminations in milk recorded herds since 1993. The fertility analysis is carried out within breed of cow but includes crossbreeding inseminations. The first test evaluation, presently under development, is scheduled in January 1998, and the first official female fertility evaluation will be released in July 1998. Male fertility estimates will be distributed to bulls owners only, for management purpose.

Some questions are still under investigation. Could heifer and lactating cow fertility be considered as the same trait ? Do some additional traits, as calving first insemination interval, need to be evaluated ?

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## 1. Introduction

In France, dairy selection was oriented toward fat and protein yields and type in the 70's. Gradually, with the quota system, fat has been removed from the breeding objective. Little attention, however, has been given to functional traits other than udder shape. A negative genetic trend is expected for female fertility, as an indirect response to dairy selection, and a decrease in fertility has been observed in the last 20 years. In 1995, it was decided to improve the recording system of functional traits and to implement new genetic evaluations as quickly as possible, in order to include these functional traits in the breeding objective.

Female fertility is an economically important trait, because it affects direct reproduction costs and influences calving interval, calving season, and involuntary culling rate. Boichard (1990) estimated by dynamic programming that the economic value of conception rate (CR) reached 20FF per CR unit. Consequently, the economic weight of one CR genetic standard deviation reaches 20-30% the corresponding value for production.

In this paper, we report the characteristics of the national evaluation for this trait, to be released in July 1998.

## 2. Definition of the trait

The French national data base routinely collects artificial insemination (AI) in milk recorded herds since 1995 and includes all inseminations since 1993. Table 1 reports the number of inseminations recorded in each breed.

Table 1. Number of inseminations per breed (November 1997 test evaluation)

Breed	# AI
Holstein	12 566 614
Normande	2 022 072
Montbéliarde	1 507 589
Others (12 breeds)	286 437

When merged with calving dates, this AI information makes it possible to compute all classical fertility criteria proposed in the literature. However, many fertility criteria may be affected by the management policy of the farmer, who determines the calving insemination interval and the number of services for each cow and may let them vary according to the merit or the production of the cow. In contrast, once an insemination is planned, the objective is to maximize its success rate (called «conception rate » throughout this paper). Moreover, CR could be defined for each insemination and, therefore, can be modeled more accurately than the other criteria. As a direct consequence, CR characterizes the effect of the cow (or her sire and

maternal grand sire), *ie* the female fertility, as well as the effect of the service sire, *ie* the male fertility.

A basic problem is to assess the result of each insemination. Accurate measures, as echography, rectal palpation, or progesterone test, are not routinely available in France. Calving rate could be defined only when a subsequent calving is observed. On the other hand, non-return rate is not accurate. Therefore all the available information was used to define an intermediate trait, according to the following rules.

- when there was a subsequent calving, the successful insemination was defined as the closest service to the theoretical conception date, supposed to take place 280 days before calving. Moreover, the interval from successful service to calving was restricted to 268-290 days. Subsequent inseminations within the same parity were discarded, whereas preceding inseminations were considered as failed.
- when there was no subsequent calving, all inseminations but the last were considered as failed. The last insemination was considered as successful, except when days in milk in current lactation were more than 260 days and the insemination was older than 340 days, *ie* when the cow was likely to have been culled for sterility.
- moreover, when several inseminations occurred within a 4-day period, only the first one was considered.

### 3. Model of analysis

All inseminations were assumed to be repetitions of the same trait. Investigations are still needed to assess whether heifer and lactating cows could be considered as the same trait or if a bivariate analysis is required.

Both male and female fertility were considered. However, male fertility, measured by the service bull effect, might result from genetic and non genetic effects (semen processing...), and no attempt was made to distinguish between these two components. As a consequence, the service bull effect was considered as an environmental effect. Presently, the model for male fertility appears difficult to improve, because unfortunately the semen batch number is not recorded.

The trait is binary and, from a theoretical point of view, the threshold model would be the

most appropriate statistical framework. However, because the incidence of the trait is intermediate (close to 50%) and quite homogeneous across levels of fixed effects, Boichard and Manfredi (1994) found that linear and threshold models provided very similar results. Consequently, a linear model has been chosen for genetic evaluation, basically for the sake of simplicity.

Finally, the model of analysis included the fixed effects of

- the herd-year of insemination combination,
- the year-technician combination,
- month-year-region,
- week day-year-region,
- parity-year-region,
- year-calving insemination interval (10-day classes) for lactating cows, or year-age at insemination (months) for heifers,
- the breed of service bull.

The model also included the random effects of

- the service bull, assumed to be  $N(\mathbf{0}, \mathbf{I} \sigma_b^2)$  distributed,
- the cow, assumed to be  $N(\mathbf{0}, \mathbf{I} \sigma_c^2)$  distributed,
- the sire and the maternal grand-sire of the cow, assumed to be  $N(\mathbf{0}, \mathbf{A} \sigma_s^2)$  distributed.

Variance components were those estimated by Boichard & Manfredi (1994), and corresponded to a heritability and a repeatability of 2 and 5%, respectively, and a service bull variance / total variance ratio of 1%. Because of the very low heritability level, fertility was analyzed with a sire + maternal grand sire model.

### 4. Perspectives

The first official fertility evaluation will be released in July 1998, after a test run in January 1998. Subsequently, fertility evaluations are planned every year in July. Only female fertility proofs of AI bulls will be published. The definition of an overall economic index including female fertility as well as production and other functional traits will be proposed in Spring 1998. Male fertility estimates will be distributed to bull's owner for management purpose.

The following topics need additional investigations :

- Interest of additional traits : In addition to conception rate, an internal and unofficial evaluation will be implemented for calving first insemination interval, as an indicator of post-partum sexual activity. However, this trait is highly influenced by management practices

and its interest in selection should be validated before any evaluation release.

- Male fertility : Recording of semen batch number is highly encouraged. It appears to be a prerequisite for an accurate monitoring of semen processing, and to distinguish genetic and environmental factors on male fertility.
- Heifer fertility : Genetic evaluations of sampling bulls based on inseminations during the first lactation of the first crop of daughters are quite inaccurate. Accounting for heifer inseminations can greatly increase the amount of information. However, the magnitude of the genetic correlation between heifer and lactating cow fertility is still discussed in the literature and is probably less than one. We

plan to obtain new estimates from our own data sets.

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### **References**

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