

# First Heat Detection in Relation to Moment of First Insemination in Lactating Cows

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## Abstract

Genetic parameters for the fertility traits interval between calving and first heat (ICH) and interval between calving and first insemination (ICI) were estimated. Data on ICH was derived from the Ovalert® system introduced by CRV. This system is using pedometers and registers the activity pattern of a cow. From this pattern the moment of estrus can be derived. The average ICH was at 55 days, ranging from 15 to 200 days. The average ICI was 78 days, ranging from 15 to 308 days. The heritability for ICH was 0.06, for ICI the heritability was 0.10. The genetic correlation between ICH and ICI was very strong (0.95). The correlation shows that the moment of first insemination is a close representation of the moment of the first heat.

**Key words:** fertility traits, heritabilities, genetic correlations, dairy cows, first heat

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## Introduction

An important aspect in the profitability of dairy herds and improved reproduction is estrus detection. Estrus detection is traditionally performed by visual observation. The increase of herd size has caused a decrease in available time per animal. Because of this decrease in observation time per cow it is difficult to detect estrus by visual observation on large farms. This can cause losses of income due to unexploited potential of milk- and calf production. Increasing estrus detection can improve insemination results, calving interval and the total pregnancy rate (Firk *et al.*, 2002; Holman *et al.*, 2011; Saint-Dizier and Chasant-Maillard, 2012).

In September 2011 the Ovalert® system was introduced by CRV. Using pedometers, this system registers the activity pattern of a cow. From this pattern the farmer can derive moment of estrus and the right moment of insemination.

The objective of the present study is to estimate genetic parameters for ICH and ICI and the relationship between both traits in lactating cows.

## Materials and Methods

### Materials

A dataset was used with data recorded between January 2011 and November 2012 (n = 12,081). The dataset contains information about the herd, parity, date of calving, the moment of first estrus and the moment of first insemination.

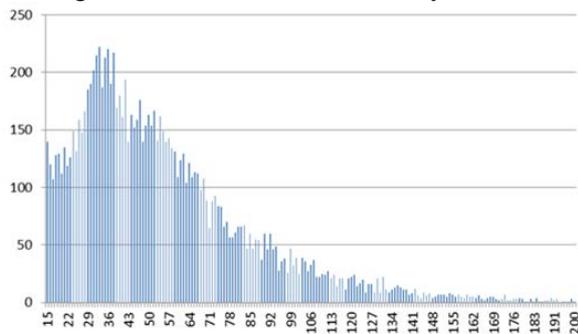
Estrus detections before 14 days after calving are not very reliable because first ovulation cannot be expected within 14 days after parturition (McDougal *et al.*, 1995; Rajamahendran *et al.*, 1990; Savio *et al.*, 1990; Thatcher and Wilcox, 1973). Therefore the records with an ICH of  $\leq 14$  days were removed from the data set (n = 967). For the same reason, records with an ICI of  $\leq 14$  days were not included in the data set. ICH records of more than 150 days were set to 150 days (n = 166) to reduce the effect of extreme values on the genetic parameter estimations.

Only records of animals that were at least 87.5% Holstein Friesian were included.

After the edits on the data, there were 11,114 records left from 10,777 cows. There are 289 herds in the dataset with on average records of 39 cows per herd (minimum of 1 cow, maximum of 302 cows). Most cows have one record (n = 10,440), and 337 cows have two records.

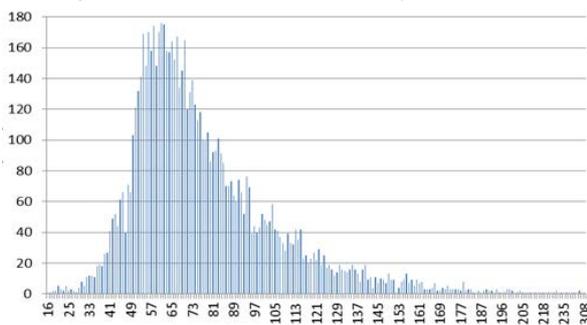
In figure 1 the frequencies of ICH are shown. ICH ranged between 15 en 200 days. The period between 30 and 40 days after calving show a peak for the detection of the first heat. Average ICH was at 55 days. This is comparable to the averages that were found in literature, 52.2 days by Ververs *et al.*, (2010) and 55.2 days from Sakaguchi *et al.*, (2004).

**Figure 1.** Frequency of the interval between calving and first estrus detection (days).



In figure 2 the frequencies of ICI are shown. They ranged between the 15 and 308 days. The highest frequency of ICI can be between 50 and 80 days. The average ICI is 78 days which is comparable to literature. Eghbalsaid (2011) found an average ICI of 74.5 days, Haile-Mariam *et al.* (2013) reported an average of 86 days, whereas Pritchard *et al.* (2013) and Řehák *et al.* (2012) reported resp. 82.5 and 83.1 days.

**Figure 2.** Frequency of the interval between calving and first insemination (days).



### Parameter estimation of fertility traits

Genetic parameters were estimated over all lactations for ICH and ICI using ASReml (Gilmour *et al.*, 2006). For ICH the heritabilities were also estimated within lactations 1 to 3.

Heritabilities were estimated univariately. The genetic correlation between ICI and ICH was estimated in a bivariate analysis. Parameters were estimated according to the following models:

$$Y1_{ijkl} = \text{HERD}_i + \text{CYM}_j + \text{ANIM}_k + \text{PAR}_l + e_{ijkl}$$

$$Y2_{ijk} = \text{HERD}_i + \text{CYM}_j + \text{ANIM}_k + e_{ijk}$$

where:

$Y1_{ijkl}$  = Interval from calving to first estrus detection (overall and within lactations 1,2,3)

$Y2_{ijk}$  = Interval from calving to first insemination

$\text{HERD}_i$  = Herd number of the cow

$\text{CYM}_j$  = Year\*month of calving

$\text{ANIM}_k$  = Animal

$\text{PAR}_l$  = Parity of the cow (not present for traits within lactation)

Error $_{ijkl}$  = Error term of  $Y1_{ijkl}$  and  $Y2_{ijk}$  describing the unexplained variation by the model

Animal and error are random effects, other effects are fixed. For the animal effect pedigree data (with sire-dam structure) was included.

## Results and Discussion

### Heritabilities

The estimated heritabilities of ICH and ICI are given in table 1.

The heritability of 0.10 for ICI is higher than reported by Haile-Mariam *et al.*, (2013) (0.024) and 0.04 Pritchard *et al.* (2013) (0.04), but is comparable to the  $h^2$  of 0.08-0.09 within lactations found by de Haer (2009).

**Table 1.** Heritability ( $h^2$ ), standard error of  $h^2$  (SE) and the genetic standard deviation (SD) for ICH and ICI.

	$h^2$	SE	SD (days)
ICH	0.06	0.016	6.63
ICH – lac1	0.07	0.017	7.30
ICH – lac2	0.07	0.017	7.32
ICH – lac3	0.07	0.017	7.50
ICI	0.10	0.024	8.24

### Genetic correlation

The genetic correlation between the overall traits ICH and ICI is estimated at 0.95 (se = 0.057). This shows that ICH and ICI can be considered as the same trait and that ICI is a good representation of ICH.

For this moment we can conclude that because of the high correlation between both traits it is not necessary to undertake action for improvement of the ICI trait because it is a good representation of ICH.

### Conclusions

- Average ICH is 55 days
- Average ICI is 78 days
- Estimated heritability of ICH is 0.06 (se = 0.016)
- Estimated heritability of ICI is 0.10 (se = 0.024).
- With a genetic correlation of 0.95 (se = 0.057) between both traits it is concluded that the moment of first insemination is closely representing the moment of first heat.

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