EFFECTS OF SELECTION FOR A SHORT WEANING-TO-OESTRUS INTERVAL ON DISTRIBUTION OF DATA

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SUMMARY

Distribution of weaning-to-oestrus intervals was evaluated within the selection and control line of a selection experiment on a short weaning-to-oestrus interval. Distributions of both lines could be described best by a mixture of a normal and an exponential distribution. Estimated density functions were almost identical over lines, but in the selection line more sows were in the normal distribution part.

INTRODUCTION

Normally, sows are expected to return to oestrus within a week after weaning. A period of anoestrus after weaning, longer than a week, is often found to be associated with stress, or severe body weight losses, caused by a negative energy and/or protein balance during lactation (reviewed by Ten Napel et al., 1994a). A delayed return to oestrus is especially a problem in first-litter sows.

Estimates of between-breed variation and heritabilities of weaning-to-oestrus and farrowing intervals confirm that genotype affects resumption of cyclic activity (Fahmy et al., 1979; Johansson and Kennedy, 1985; Ten Napel et al., 1994b).

In some studies the distribution of weaning-to-oestrus intervals was shown (Fahmy et al., 1979), but distributions with a substantial number of sows have never been studied.

The aim of this study was to evaluate effects of selection for a short weaning-to-oestrus interval in first-litter sows on the distribution of data.

MATERIALS AND METHODS

A selection experiment was started in 1980 involving a selection and a control line. The selection line was selected for a short weaning-to-oestrus interval after weaning the first litter, and in the control line selection was avoided. The experiment consisted of a foundation population and eight generations of selection.

Gilts were mated at about eight months of age. Litters were standardized at birth within lines at eight piglets. Piglets were weaned after a five-week lactation. After weaning, sows remained in the mating stable until they showed oestrus spontaneously. Culling because of anoestrus, or treatment with hormones, was not practised. Weaning of litters occurred weekly on thursdays. All sows in the mating stable, not yet seen in oestrus, were moved to a new pen on the same day. Checks for oestrus were made twice a day, and in the morning an intact teaser boar was used. Details of mating scheme, housing conditions, and feeding and managing procedures were described elsewhere (Merks, 1989; Ten Napel et al., 1994b).

To study the distribution of weaning-to-oestrus intervals, data were combined across generations within lines. Observed weaning-to-oestrus intervals ranged from 1 to 187 days in the selection and from 1 to 234 days in the control line. Distributions within lines were shown elsewhere (Ten Napel et al., 1994b). They were evaluated by estimating the density function. Agha and Ibrahim (1984) described a maximum likelihood algorithm for estimation of parameters of a mixture of distributions, in which all distributions are of the same type. We extended this algorithm to mixtures of distributions of different types, by using the entire density function of the underlying distributions. Models were compared based on their maximized log likelihood. The optimal starting position of the exponential distribution was estimated using a grid search with steps of one day. Goodness of fit was checked by performing a linear regression of observed number of sows with a particular weaning-to-oestrus interval, on the number of sows predicted with the estimated composite density function.

RESULTS

In both lines, a mixture of a normal and an exponential distribution fitted much better than any other model. Mean and standard deviation of the normal distribution, and mean and starting position of the exponential distribution were alike in both lines (Table 1). The only difference between lines was that the fraction of sows in the normal distribution part was higher in the selection line.

Table 1. Maximum likelihood estimates of parameters of a density function of a normal and an exponential distribution fitted on within-line distributions of weaning-to-oestrus intervals.

	selection line (N=1116 sows)	control line (N=1017 sows)
Normal distribution:		
- fraction	.393	.314
- mean	5.57	5.63
- standard deviation	1.08	.97
Exponential distribution:		
- fraction	.607	.686
- mean	36.8	36.9
- starting position	5	5
Variation explained (%)	94.9	92.9

Incidence of weaning-to-oestrus intervals predicted with the composite density function explained variation in observed incidence very well. Figure 1 shows the curve of the density function estimated in the selection line, predicting the incidence of weaning-to-oestrus intervals in a group of 1000 sows.

DISCUSSION

If weaning-to-oestrus intervals can be considered as a 'waiting-time' problem, one would expect that the distribution is best described with an exponential density function (Feller, 1957). The log likelihood of this type of density function, however, was 452 and 347 lower in the selection and control line respectively, than the log likelihood of the composite density functions. Models were different ($P<0.01$) when the difference in log likelihood was larger than 6. The estimated functions strongly suggest that weaning-to-oestrus intervals can be divided in normal and prolonged intervals.

This distinction can also be argued from a biological point of view. During the entire life of a sow, primordial follicles are developing into antral stages. When development to preovulatory size is not continued, antral follicles become atretic and disappear (Britt et al., 1985). In the weaned sow, a specific pulsatile Luteinizing Hormone (LH) pattern is thought to be the major factor permitting antral follicles to escape from atresia and to grow to preovulatory size. During lactation the suckling stimulus is likely to be responsible for decreased pulsatile release of LH

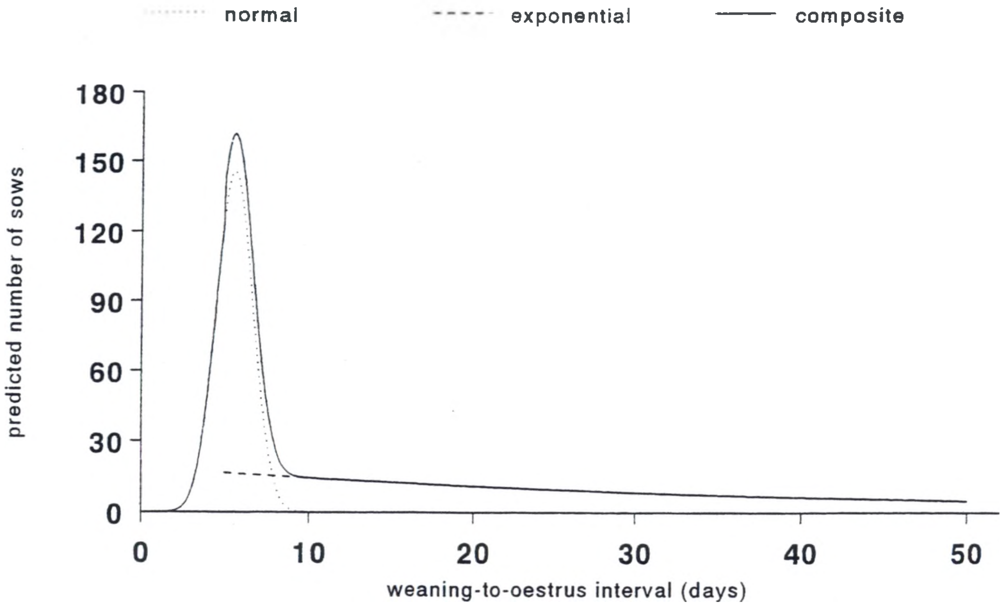

Figure 1. Predicted incidence of weaning-to-oestrus intervals in a group of 1000 sows, calculated with the density function estimated in the selection line (truncated after day 50).

(Foxcroft, 1992). However, a gradual increase in LH secretion causes a gradual increase in size of antral follicles (Kunavongkrit et al., 1982). At weaning, inhibition by suckling disappears, which results in a sudden elevation of LH levels and an increased frequency of pulses (Shaw and Foxcroft, 1985). Sows will be in oestrus within four to six days after the specific LH release (Britt et al., 1985). Sows which remained anoestrous for some time after weaning, were lacking the pattern of increasing pulsatile release of LH during lactation (Tokach et al., 1992). Hence, we assume that weaning-to-oestrus intervals will be normal when suckling is restricting LH release and follicular development, but prolonged when other factors, such as metabolic hormones, impair follicular growth.

As a consequence, it may be more appropriate to present resumption of cyclic activity, with numbers of sows in oestrus within seven or eight days after weaning, than average weaning-to-oestrus intervals.

In the selection line, the fraction of sows in the normal part of the distribution was 8% higher than in the control line, which is a value averaged across generations. In generation 7 and 8, the difference was 11%. We therefore conclude that genetic selection reduced the average weaning-to-oestrus interval by an increased number of sows with a normal interval.

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