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Reproductive performance of second parity sows: Relations with subsequent reproduction

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ABSTRACT

The objective of this study was to determine relations between reproductive performance, i.e. being a repeat breeder and litter size, in 2nd parity and reproductive performance in later parities. In addition, relations between the 1st and 2nd parity litter size and litter size in later parities were determined. First, 184,135 records from 46,571 sows were used to analyze the effect of being a repeat breeder in 2nd parity on subsequent farrowing rate, litter size and parity number at culling. Second, 161,521 records of 39,654 sows were used to analyze the effect of litter size from 1st insemination in 2nd parity, being either low (≤10 piglets total born), medium (11–13) or high (≥14), on subsequent litter size, farrowing rate and parity number at culling, with litter size in 1st parity included in the model as well. In total 15.7% of the sows inseminated in 2nd parity were a repeat breeder in 2nd parity. Being a repeat breeder in 2nd parity did not affect litter size in subsequent parities, however it decreased farrowing rate in parity 3 (4.1%) and 4 (3.4%), but not in later parities ($P<0.05$). Repeat breeders in 2nd parity were culled on average 2 parities earlier compared with non-repeat breeders (resp. parity 5 vs. 7, $P<0.05$). Sows with a low litter size in 2nd parity showed a lower litter size in parity 3 and up compared with sows with a medium or high litter size in 2nd parity ($P<0.05$). The magnitude of this effect, however, decreased if litter size in 1st parity increased. For example, the difference in piglets born in parity 3–5 between sows with a low and high litter size in 2nd parity was −4.6 piglets for sows with a low litter size in 1st parity. This difference decreased to −3.3 piglets for sows with a high litter size in 1st parity. Sows with a high litter size in 2nd parity had 2% lower farrowing rate in parity 3, but not in later parities. Sows with a low litter size in 2nd parity were culled 1 parity earlier compared with sows with a medium or high litter size in 2nd parity. This study showed that a large part of the sows with poor reproductive performance in 2nd parity can be expected to have a poor reproductive performance in subsequent parities. The effect of 2nd parity litter size on subsequent litter size, however, depends on 1st parity litter size.

1. Introduction

Several papers addressed parity influences on reproductive performance, farrowing rate as well as litter size (e.g. Koketsu et al., 1999; Tummaruk et al., 2000; Hughes and Varley, 2003). Generally, reproductive performance increases with increasing parity number, reaching the highest level at parity 3 to 5 where parity changes at weaning. Second parity sows, i.e. sows of which their first litter is weaned, often have lower farrowing rates and/or smaller litter sizes compared with first parity sows (Morrow et al. 1989; 1992; Penny et al., 1971; Saito et al., 2010). The major cause of poor reproductive performance of 2nd parity sows seems to be insufficient development of the sow until onset of 1st lactation (Clowes et al., 2003b) or weight loss during this 1st lactation (Thaker and Bilkei, 2005). Lactational weight loss, induced by restricted feed or protein intake, during

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(parts of) first lactation has been demonstrated to have negative effects on follicle development at weaning and therefore on subsequent ovulation rate and embryonic survival which, in turn, can reduce farrowing rate and litter size (Clowes et al., 2003a; Prunier et al., 2003).

A reduction in reproductive efficiency of 2nd parity sows might also decrease sow longevity, as culling rates increase with decreasing reproductive performance (Sasaki and Koketsu, 2008). Lucia et al. (2000) reported that reproductive failure is the main reason for culling in young sows. More recently, Saito et al. (2010) reported that sows with a lower litter size in 2nd vs. 1st parity had a 1.2% higher culling risk compared with sows with a higher litter size in 2nd vs. 1st parity. Effects of poor reproductive performance in 2nd parity on reproductive performance in subsequent parities have been poorly described. Some indications for long-term effects of impaired reproduction in early parity are provided by Tummaruk et al. (2001), who showed that rebreeders, in general, have a higher rebreeding risk in subsequent parities.

Thus, despite the fact that reproductive performance of 2nd parity sows is often negatively affected, for example by lactation weight loss, and therefore lower than in 1st parity sows, relations with subsequent reproductive performance have not been documented. The objective of this study therefore is to determine relations between reproductive performance in 2nd parity on farrowing rate, litter size and risk of culling in subsequent parities. In addition, relations between 1st and 2nd parity litter size and litter size in later parities were determined.

2. Materials and methods

2.1. General

Data from 2000 to 2008 were available from Dutch sow farms that use the sow management program 'Farm' (Agrovision BV., Deventer, The Netherlands). Data on weaning to insemination interval, (re)breeding date, farrowing date and litter size (born alive, born dead) was available per parity for individual sows. If culled, parity number at culling was available. Parity number changed at weaning and was used as follows, parity 1 is a gilt until the end of 1st lactation, parity 2 is a sow of which her 1st litter is weaned, parity 3 is a sow of which her 2nd litter is weaned, etc. In total, 193,506 records of 48,212 sows from 87 Dutch farms were available. The 87 farms represent 6% of the sow herds in the Netherlands. The median herd size was 293, varying between 55 and 3200, which is slightly larger compared with the average in the Netherlands (265 sows, Bedrijfsvergelijking Agrovision B.V., Deventer, The Netherlands). These data were used to analyze the effect of being a repeat breeder in 2nd parity on farrowing rate, litter size and culling in parity 3 and higher, and to analyze the effect of having a low litter size in 2nd parity on farrowing rate, litter size and culling in parity 3 and higher.

To account for recording errors and to ensure data were valid and within normal physiological ranges, records were excluded if these did not meet the following criteria: age at first insemination between 160 and 400 days (median[1] 245 days), pregnancy length between 100 and 120 days (median 115 days), at least 1 piglet born alive (mean 11.5 piglet), lactation length between 10 and 41 days (mean 26.1 days) and weaning to 1st insemination interval between 0 and 35 days (median 5 days). To ensure all inseminated sows had a chance to farrow, sows with an insemination date of less than 120 days before the last farrowing date recorded on the farm were excluded. In total, 184,135 records of 46,571 sows from 87 farms remained available for analysis. This dataset will be referred to as 'FARROWING'.

Only litter size from 1st insemination was used for analyses on litter size in 3rd and higher parities, since prolonged intervals between weaning and conception in repeat breeders can positively influence litter size and thus be a confounding factor (Tummaruk et al., 2001). Repeat breeders were therefore excluded from the data used for the analysis on litter size. This resulted in 161,512 records of 39,654 sows from 87 farms. This dataset will be referred to as 'LITTER'.

2.2. Repeat breeders, farrowing rate and litter size

A sow was considered a repeat breeder (RB) when she did not farrow from first insemination after weaning and received more than 2 inseminations, more than 5 days apart, within 1 parity. Regardless of being a repeat breeder, a sow was considered to have farrowed if she produced a litter after insemination. Farrowing rate from first insemination was defined as the proportion of sows that farrowed from first insemination after weaning. Farrowing rate of repeat breeders was calculated by dividing the number of repeat breeders that farrowed by the total number of repeat breeders. Sows that did not farrow after insemination were considered culled.

Litter size is defined as the total number of piglets born (alive and dead), mummies not included. Litter size from first insemination is defined as the total number of piglets born from first insemination after weaning, i.e. excluding sows that return to estrus after first insemination after weaning.

2.2.1. Statistical analysis

Since multiple observations per farm and per sow cannot be regarded as independent units of observation, farm should be added to the statistical models as a random effect and sow as repeated measures effect; resulting in a multilevel model. However, due to the large number of data, there were computational limitations; sow effect could not be included in the models as a repeated measure, even if a random farm effect was not in the model. To study the effect of multilevel repeated and random effects without having computational restrictions, analysis was done on a randomly selected 35% of the data (n = 60,000; proc Survey select, SAS (2004)) in which multilevel analysis could be performed. Analysis on five different random selections with farm and sow effect included, showed that repeated sow effect explained between 3.5 and 3.8% of the total unexplained variance. Farm effect explained between 4.5 and 5.1%. As the repeated effect of sow was smaller than random herd effect, and a part of the variation due to sows is already included as sow level explanatory variables in the statistical models, whilst herd level explanatory variables were not available and sow effect not within computational limits when analyzing the complete dataset, we decided to only include farm as random effect in the analysis of the whole dataset. Moreover, some of the remaining variation due to sows within herds is then

[1] Median was used if variable was not normally distributed.