Factors Associated with a Single-Mating Occurrence in First-Serviced and Reserviced Female Pigs on Commercial Farms

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(Received 22 February 2008/Accepted 22 January 2009)

ABSTRACT. This study investigated associations of a single-mating occurrence (SMO) with farrowing rate and pigs born alive (PBA) in first-serviced and reserviced female pigs (females), and identified the factors associated with SMO. The data included 111,334 service and 91,233 farrowing records on 117 farms. A mating was defined as any one insemination (mating) of a female during estrus. Mixed-effects models were used to investigate reproductive performance and factors associated with SMO. In the first-service group, single-mated females had a lower farrowing rate and fewer PBA than multiple-mated females (P<0.05). In the reserve group, single-mated females also had a lower farrowing rate than multiple-mated females (P<0.05), but had PBA similar to multiple-mated females. SMO in first-service and reservice groups were 4.1 and 6.0%, respectively. Gilts were 1.030 times more likely to be mated a single time than sows (P<0.05). Gilts with age at first mating 150–224 and 225–260 days were 1.010–1.016 times more likely to be mated a single time than those with age at first mating 225–260 days (P<0.05). Sows with weaning-to-first-mating interval ≥7 days were 1.024–1.030 times more likely to be mated a single time than those with weaning-to-first-mating interval ≤6 days (P<0.05). Factors associated with a higher SMO were a reservice occurrence, being gilts, low or high ages of gilts at first mating, and prolonged weaning-to-first-mating interval.

KEY WORDS: farm management, mating frequency, returning to estrus.

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Performing multiple matings during estrus has been recommended for improving performance of female pigs (females) on commercial farms. However, a single mating frequently occurs. Increased single-mating occurrences (SMO) impair herd productivity [2, 10], because single-mated females have a lower farrowing rate and fewer numbers of pigs born alive (PBA) than multiple-mated females [1, 19]. However, risk factors associated with SMO have not been well studied on commercial farms. Reserviced females have shorter estrus duration than first-serviced females [16], and may have more SMO than first-serviced females. As number of services increases by one, farrowing rate decreases by approximately 10% [9]. No study on the association between SMO and reserviced females has been reported in reproductive performance. Additionally, parity, weaning-to-first-mating interval (WMI), age of gilts at first mating, lactation length and numbers of nursing piglets are possible risk factors for SMO, because these factors are reported to be associated with low farrowing rate and fewer PBA [2, 8]. For example, gilts have lower farrowing rates and fewer PBA than sows [2, 15]. WMI 7–12 and short lactation length are associated with lower farrowing rate and fewer PBA [7, 8]. Lower age of gilts at first mating is associated with fewer PBA [14]. Increasing percentages of females with suboptimal performance decreases herd productivity [2].

Our objectives of this study were, therefore, to investigate the associations of SMO with farrowing rate and PBA in first-serviced and reserviced females and to identify factors associated with SMO on commercial farms.

MATERIALS AND METHODS

Data collection: All producers (approximately 140 farms) in Japan using a recording software (PigCHAMP) were requested to mail their data files to the School of Agriculture, Meiji University when they renewed their yearly maintenance contract. Measurements of breeding females in the year 2002 were obtained from each data file and were used for analyses. The data analyzed in this study were a subset of a larger dataset (116,018 service and 94,200 farrowing records of 54,722 females) from a previous research performed by Takai and Koketsu [16].

Animals and farm management: Females on this study farms were mainly F1 crossbreds of Large White and Landrace, or were crossbred pigs purchased from international breeding companies. Both natural mating and artificial insemination were practiced. The recommendation was to service females during first estrus postweaning.

Exclusion criteria of collected data: Records of second or more services (1,931 service records and 935 farrowing records) were deleted, because the numbers of records were few for SMO. Missing records of farrowing events, records of sows with WMI longer than 120 days, sows with lactation length <14 and >28 days and females with reservice intervals longer than 150 days in 4,684 service records, and 2,967 farrowing records of 570 females were considered as
extreme, and were excluded. Hence, 111,334 service records and 91,313 farrowing records of 54,146 females were used for further study.

**Definition of production parameters and categorization:** A gilt was defined as a female entered into herd but not farrowed, and a sow was a female farrowed at least once. A mating was defined as any single insemination (matting) of a female during estrus. A service included one or more mating events in a 10-day estrus period [12]. Reservice was defined as returning to service within parity. Matings include natural mating and artificial insemination.

The number of matings was categorized into two groups: single and multiple mating. The number of services was also divided into 2 groups: first-service and reservice. Two parity groups were constructed: 0 and ≥ 1. Age of gilts at first mating and lactation length were categorized into the three groups on the basis of the upper and lower 25th percentiles. The groups of age at first mating were formed: 150–224, 225–260 and ≥ 261 days. Lactation length was grouped: ≤ 18, 19–23 and ≥ 24 days. The WMI was divided into three groups: ≤ 6, 7–12 and ≥ 13 days [8].

**Statistical analysis:** The observational unit was the service record or farrowing record. All statistical analyses were done with SAS software (SAS Inst., Inc., Cary, NC, U.S.A.). The standard error of the farrowing rate and SMO was obtained by a standard method [13].

Mixed-effects logistic regression analysis with contrasts was applied for binary data (farrowing rate and SMO) in the GLIMMIX procedure. The regression coefficients in SMO was applied for binary data (farrowing rate and SMO) in the GLIMMIX procedure. The regression coefficients in SMO was applied for binary data (farrowing rate and SMO) in the GLIMMIX procedure. The regression coefficients in SMO was applied for binary data (farrowing rate and SMO) in the GLIMMIX procedure. The regression coefficients in SMO was applied for binary data (farrowing rate and SMO) in the GLIMMIX procedure.

Factors associated with SMO were analyzed (Model 2). The independent variables for all females were the number of services and parity groups. The independent variable for first-serviced gilts was age at first mating groups. The independent variables for first-serviced sows were parity, lactation length, WMI groups, and number of nursing piglets. Reservice intervals were added to the independent variables for reserviced gilt and sow models.

**RESULTS**

The means of the number of matings, farrowing rate and PBA were 2.5 ± 0.01 times, 82.0 ± 0.12% and 10.1 ± 0.01 pigs, respectively (Table 1). No difference in the number of matings was found between first-serviced and reserviced females. The relative frequencies (%) of single and multiple matings in the first-service group were 4.1 and 95.9%, respectively. The relative frequencies (%) of single and multiple matings in the reservice group were 6.0 and 94.0%, respectively.

In the first-service group, single-mated gilts had 12.8% lower farrowing rates and 0.4 fewer PBA than multiple-mated gilts (P<0.05; Table 2). In addition, single-mated sows also had 12.5% lower farrowing rates and 0.5 fewer PBA than multiple-mated sows (P<0.05). Meanwhile, in the reservice group, single-mated gilts and sows had a lower farrowing rate than multiple-mated gilts and sows (P<0.05), but had PBA similar to that of multiple-mated females.

The SMO in 111,334 service records was 4.3%. Reserviced females were 1.010–1.016 times more likely to be mated a single time than first-serviced females (P<0.05; Table 3). Gilts were 1.030 times more likely to be mated a single time than sows (P<0.05). Gilts with age at first mating 150–224 and ≥ 261 days were 1.010–1.016 times more likely to be mated a single time than those with age at first mating 225–260 days (P<0.05). Sows with lactation length ≤ 18 days

<table>
<thead>
<tr>
<th>Measurements</th>
<th>n</th>
<th>Mean</th>
<th>10th</th>
<th>90th</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of matings</td>
<td>111,334</td>
<td>2.5</td>
<td>2</td>
<td>3</td>
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<td>Parity</td>
<td>100,443</td>
<td>2.8</td>
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<td>Age of gilts at first mating (day)</td>
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<td>285</td>
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<tr>
<td>Lactation length (day)</td>
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<td>21.0</td>
<td>16</td>
<td>25</td>
</tr>
<tr>
<td>Nursing piglets</td>
<td>79,522</td>
<td>9.4</td>
<td>7</td>
<td>11</td>
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<tr>
<td>Weaning-to-first-mating interval (day)</td>
<td>79,493</td>
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<tr>
<td>Farrowing rate (%)</td>
<td>111,334</td>
<td>82.0</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Pigs born alive</td>
<td>91,313</td>
<td>10.1</td>
<td>6</td>
<td>14</td>
</tr>
</tbody>
</table>

1) Of 79,522 lactation length records, 29 sows had missing records in serviced dates.
were 0.994 times more likely to be mated a single time than those with lactation length 19–23 days (P<0.05). Sows with WMI ≥ 7 days were 1.024–1.030 times more likely to be mated a single time than those with WMI ≤ 6 days (P<0.05).

No association of the numbers of nursing piglets and reser-vice intervals with SMO was found. In addition, no interac-tions between these factors were found with SMO.

DISCUSSION

Our study showing lower farrowing rate in the reserviced females than first-serviced females was consistent with previous reports [15, 17]. The present study showing that reserviced females had higher SMO than first-serviced females may be partially due to different patterns of LH surge between first-serviced females and reserviced females. In heifers, repeat breeders had a lower magnitude of the preo-vulatory LH peak than non-repeat breeders [3]. Addition-ally, reserviced females had shorter estrus duration than first-serviced females [5, 15]. Shorter duration of estrus in reserviced females than first-serviced females may result in more SMO. In practice, adding prostaglandin F2α to the semen at the time of artificial insemination was suggested for improving farrowing rate in reserviced sows [4].
In the first-service groups, the present study showing lower farrowing rate and fewer PBA in single-mated females than multiple-mated females was consistent with previous reports [1, 19]. In the reserve groups, the present study also indicated that performing multiple matings might be critical for increasing farrowing rate. Performing multiple matings has more opportunities for matings within an optimal period that was 24 hr before ovulation [5] in both first-serviced and reserviced females. Additionally, no biological explanations were found on our result showing no difference in PBA between SMO and multiple matings in reserviced females.

High percentages of SMO in gilts and sows with WMI ≥ 7 days suggested that producers might not be able to accurately detect estrus behavior of these females. Females at low parity had prolonged WMI [6], that shortened estrus duration [5, 15]. Increasing feed intake during lactation [6] shortened WMI, and may indirectly increase estrus duration. In addition, estrus detection should be frequently performed with a matured boar, because the presence of a boar induced high pulse frequency of LH and long estrus duration [11, 18].

Our result showing the relationship between low SMO and short lactation length indicates that producers were trying to perform multiple matings, especially for sows with short lactation length. Short lactation length has been well known to be associated with suboptimal reproductive performance [7, 16].

In conclusion, practicing multiple matings is a key to improve reproductive performance in both first-serviced and reserviced females. Factors associated with a higher SMO are a reserve occurrence, being gilts, low or high age at first mating and prolonged WMI.

The limitation of this study may be the lack of information on genotype, health, environment, and mating management including a ratio of artificial insemination and natural mating. However, even with these limitations, the present study provides practicing veterinarians and producers with valuable information that can be advantageous in designing efficient herd-management systems.

ACKNOWLEDGEMENTS. The authors gratefully thank cooperative swine producers for providing their valuable data to be used in this study, and the PigCHAMP staff in Global Pig Farms, Inc. (Shibukawa, Gunma, Japan) for their technical assistance. This research is supported by Research Project Grants from Meiji University and the Ministry of Education, Culture, Sports, Science and Technology of Japan.

REFERENCES