

Effect of mating frequency and weaning-to-mating interval on sow reproductive performance

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Summary

Objective: To investigate the effect of mating frequency (MF) and previous weaning-to-mating interval (PWMI) on fertility and litter size in female swine.

Methods: Reproductive data were collected from 20 Minnesota and Iowa breeding herds, covering a 7-year period from January 1, 1986–December 31, 1992. Natural mating was used in all herds during the study period. Females bred one, two, or three times during a single estrus were included in the study to compare fertility rates (conception rate, farrowing rate, and adjusted farrowing rate) and litter size between mating frequency. Previous weaning-to-mating intervals were also used to investigate possible interactions with MF on subsequent fertility rates and litter size.

Results: Compared to gilts that were mated twice, single-mated gilts had significantly lower ($P < .001$) conception rates, farrowing rates, and adjusted farrowing rates. Similarly, single-mated sows had significantly lower ($P < .001$) conception rate, farrowing rate, and adjusted farrowing rate compared to those mated

twice. No differences in fertility rates were observed between double-mated and triple-mated females. Mating frequency was associated with litter size in gilts, but not in sows. Single-mated gilts had fewer ($P < .001$) total-born and liveborn pigs than double- and triple-mated gilts. Litter size did not differ between double-mated and triple-mated gilts. There was no interaction between MF and PWMI that was associated with subsequent fertility and litter size. Sows with 7–10 day PWMI had smaller ($P < .001$) subsequent litter sizes compared with those that had 3–6 day or 11–14 day intervals.

Implications: Double matings with natural service may improve female fertility rates. Double matings may improve the litter sizes of gilts, but not sows. Triple matings did not improve fertility rates and litter sizes compared with double matings.

Keywords: swine, mating frequency, weaning-to-mating intervals, fertility rate, litter size

Received: May 6, 1997

Accepted: February 4, 1998

The influence of mating frequency (MF) on reproductive performance of the sow has been reported in a number of studies.^{1–6} Double matings during an estrus period have been reported to improve conception rate and litter size compared with single matings.^{1–4} Sows bred three times in each estrus period had improved conception rates and litter sizes compared with those bred twice with either natural service⁵ or artificial insemination (AI).⁶

Weaning-to-mating intervals are also associated with subsequent litter size. Sows with weaning-to-mating intervals between 7–10 days had smaller subsequent litter size than those with weaning-to-mating intervals either between 3 and 6 days or between 11 and 14 days.⁷ In a study investigating weaning-to-mating intervals, Leman⁸ concluded that a single mating is sufficient for sows that come into estrus 3–5 days after weaning.

The objective of this study was to evaluate the relationship between MF during the single estrus period and sow reproductive performance, which included conception rate, farrowing rate, and litter size under

farm conditions. We also investigated the possible interaction between previous weaning-to-mating intervals (PWMI) and MF on these parameters.

Materials and methods

Database

Reproductive data were collected from 20 Minnesota and Iowa breeding herds, covering a 7-year period from January 1, 1986–December 31, 1992. Herd sizes ranged from 102–988 females. Variation in female inventory during the 7-year study period never exceeded 10%.

Breeding records of individual sows included sow ID, entry date, age at first mating, parity, service number in current parity (e.g., service number is 2 if a female was previously bred and returned to estrus during the current parity), mating date, number of matings during a single estrus period, return on 21 days postmating, service outcome (either farrowed or not), litter conception date, total born pigs, liveborn pigs, lactation length, and weaning-to-mating intervals. For the purposes of this study, a “mating” was defined as any one insemination of a breeding female; and a “service” was defined as an estrus period during which the female received one or more matings.

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This article is available online at <http://www.aasp.org/shap.html>

Figure 1

Gilts distribution: (N=62,000)	22.1%	59.4%	17.7%	0.8%
Mating frequency:	1	2	3	4
Sow distribution: (N=75,556)	15.4%	62.5%	21.4%	0.7%

Mating frequency distribution in dataset

Natural service was used on all farms during the study period. The database contained 153,936 mating events, of which 89.4% (137,556) were associated with first services, 9.4% (14,468) with second services, and 1.2% (1912) with third through seventh services. At first service, the majority (60.7%) of females were bred twice (Figure 1). Only 0.7% of females were bred more than three times during a single estrus period. This small proportion of observations was excluded from the data analysis.

Lactation lengths ranged from 8–42 days. A small proportion (0.8%, n=697) of sows that had lactation lengths out of that range were excluded from the data analysis.

Sow parities at farrowing ranged between 2–15 (gilt data were analyzed separately). Because of a small number of high-parity sows at farrowing, parity was categorized as 2, 3, 4–5, and ≥ 6 .

To test the interaction of PWMI with MF on sow reproductive performance, sow data were categorized based on their PWMI into one of the following three PWMI categories:

- 3–6 days,
- 7–10 days, and
- 11–14 days.⁷

The proportion of females in each MF category (one, two, or three) was relatively constant across the PWMI categories:

- single matings per service ranged from 14.1%–14.4%,
- double matings per service ranged from 62.3%–68.6%, and
- triple matings per service ranged from 17.3%–23.6%.

Statistical analysis

Data associated with gilt and sow matings were analyzed separately using SAS.⁹ The CATMOD procedure was used to analyze fertility parameters (dependent variables), including:

- 21-day conception rate,
- farrowing rate, and
- adjusted farrowing rate, defined as number of females farrowed ÷ (number of females bred – number of females culled due to nonreproductive reasons and number of females that died).

Independent variables included farm, year, breeding month (nested within year), and ME. Parity category, interaction between parity category and ME, and previous lactation lengths (treated as continuous

variables) were included in the model for sows. Previous weaning-to-mating interval category and its interaction with parity category and ME were included in the model. A statement of “contrast” was used to compare the fertility rate between MF for both gilt and sow data.

The GLM procedure was used for analysis of litter size data. Dependent variables were number of total born pigs, number of liveborn pigs, number of stillborn pigs, and number of mummified pigs. Independent variables included farm, year, litter conception month (nested within year), and ME. Age at first mating (days), treated as a continuous variable, was included in the model for gilt data. Parity category, interaction of parity category with ME, and previous lactation length, treated as a continuous variable, were included in the model for sow data. Previous weaning-to-mating interval and its interaction with parity category and MF were included in the model. Least-squares means were requested with “lsmeans” following model statement. Standard errors for the means and probability comparison between the means were requested using options of “stderr” and “pdiff,” respectively.

Results

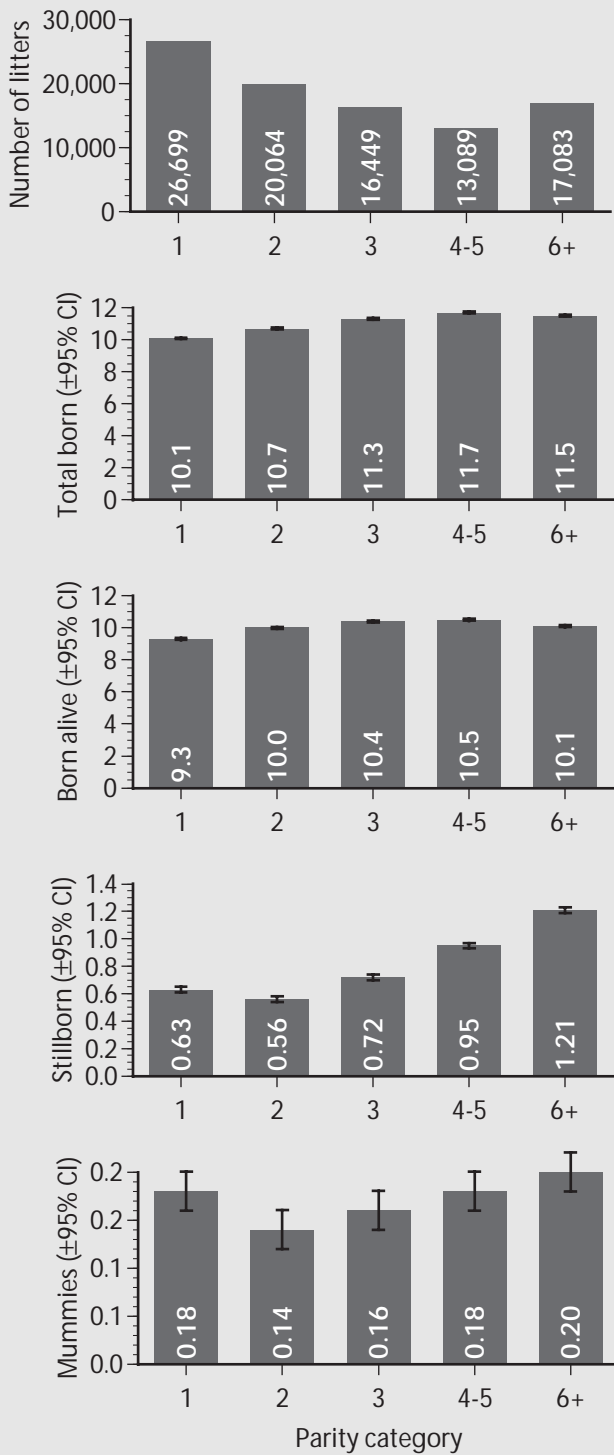
Fertility

In the statistical models used, effects of year were observed ($P < .001$) for gilts and sows. Month effects were also observed ($P < .001$), and were consistent with a seasonal effect. Previous lactation lengths were not associated ($P > .15$) with farrowing rate and adjusted farrowing rate.

In sows, parity category was associated ($P < .001$) with litter size (Figure 2). An interaction between MF and parity category was not observed ($P > .05$).

Mating frequency was associated ($P < .001$) with conception rate, farrowing rate, and adjusted farrowing rate in both gilts and sows. In both gilts and sows, conception, farrowing, and adjusted farrowing rates were significantly lower ($P < .001$) for females that received only one mating compared to those that received two or three matings (Figure 3). Farrowing rate was significantly lower ($P < .001$) for gilts that received two matings compared to those that received three matings; but conception and adjusted farrowing rates did not differ between gilts receiving two versus three matings. In sows, no differences ($P > .05$) in fertility rates were observed between MF 2 and 3.

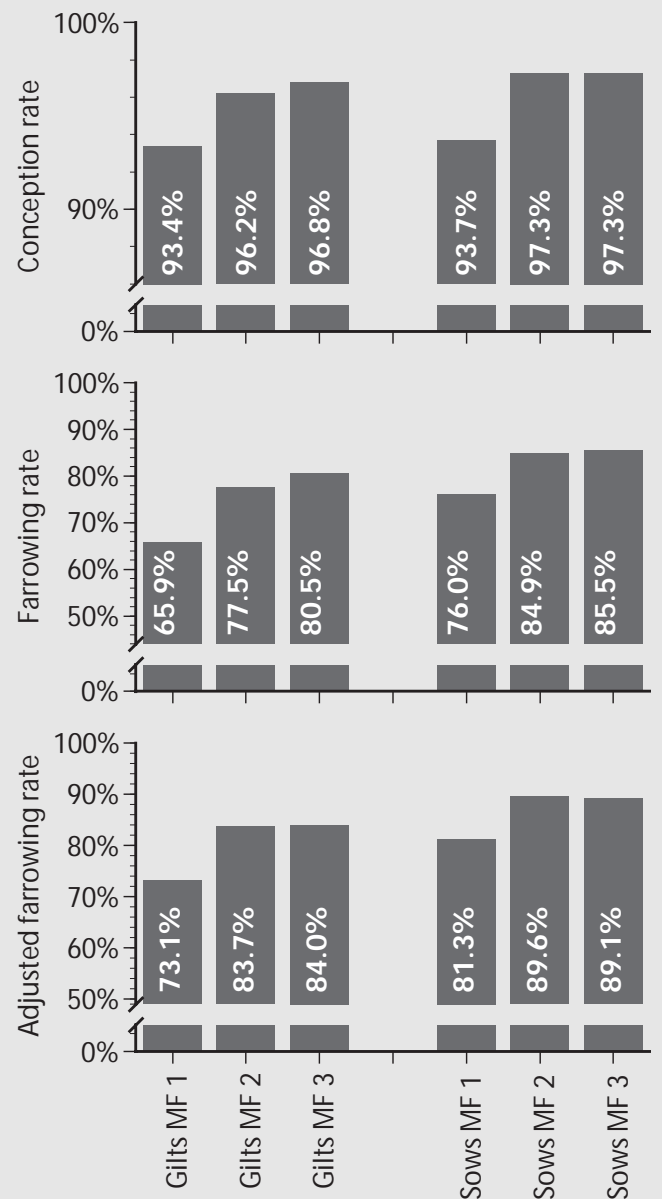
Across all PWMI categories, females that received only one mating had

Figure 2

significantly lower ($P < .001$) conception, farrowing, and adjusted farrowing rates (Figure 4). Previous weaning-to-mating intervals were associated ($P < .05$) with sow fertility rates.

Litter size

The number of liveborn and total born per litter was significantly lower ($P < .001$) in gilts that received only one mating compared to those

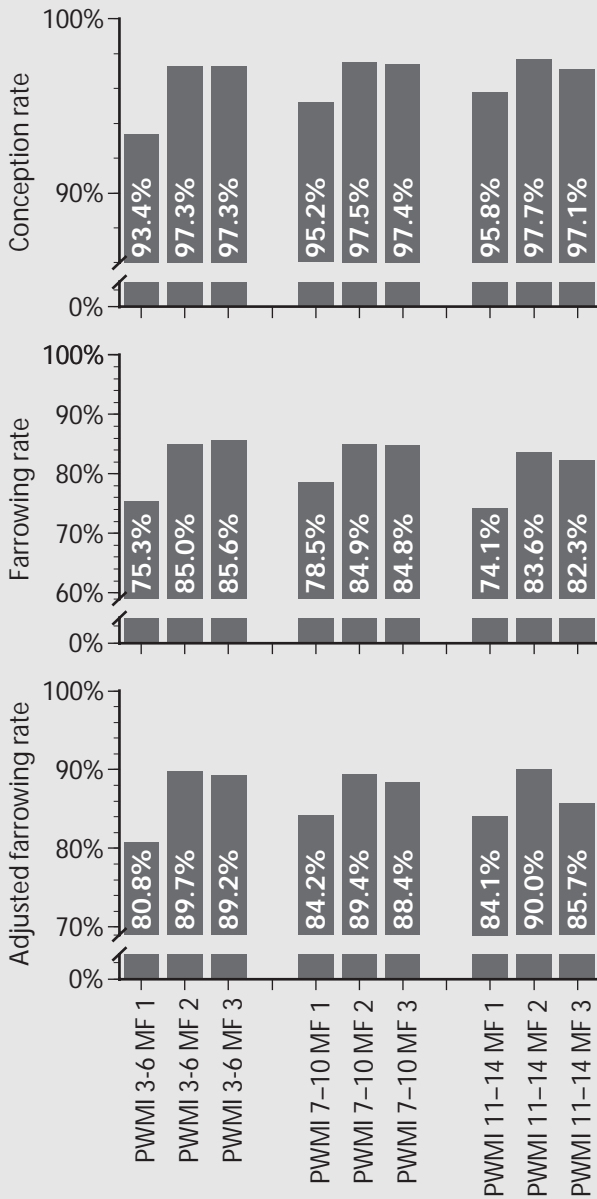
Figure 3

Fertility of females having different mating frequency. Mating frequency (MF) 1 had lower ($P < .001$) conception, farrowing, and adjusted farrowing rates than MF 2 and 3 in gilts and sows. A difference ($P < .001$) in farrowing rate was detected between MF 2 and 3 in gilts.

that received two or more matings (Figure 5). No differences ($P > .05$) were observed in total born and liveborn pigs between MF 2 and 3, nor were there any differences ($P > .05$) in numbers of stillborn and mummified pigs across all three mating frequencies. In sows, no differences ($P > .05$) in total born, live born, stillborn, and mummified pigs were detected across mating frequencies.

Sows with PWMI of 7–10 days had fewer ($P < .003$) total born and liveborn pigs compared with those with PWMI of 3–6 days and 11–14 days (Figure 6). We detected no interactions ($P > .05$) between PWMI and MF on litter size.

Figure 4



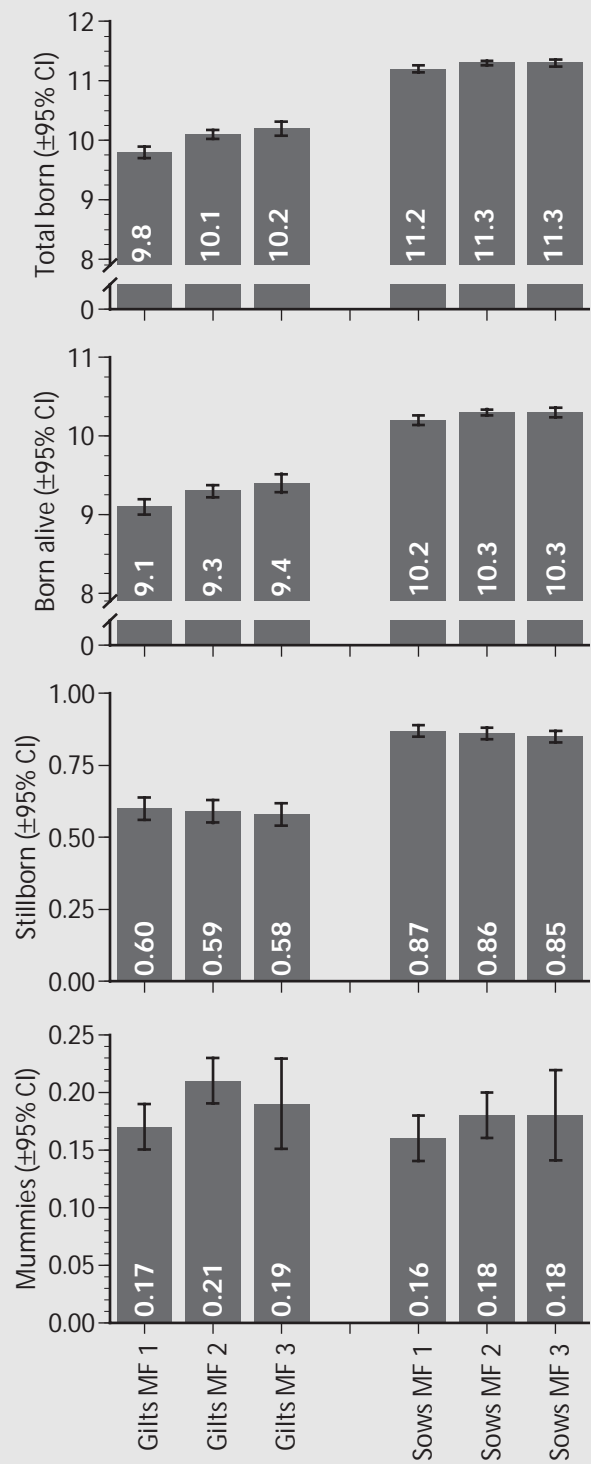
Fertility of sows having different mating frequency (MF) grouped by previous weaning-to-mating interval (PWMI)

MF 1 had lower ($P < .001$) conception, farrowing, and adjusted farrowing rates than MF 2 and 3 across groups.

Discussion

Our observation that fertility was improved in females that received two matings is consistent with previous studies.¹⁻⁴ In sows, receiving two matings may increase fertility rate, but not litter size. Gilts that received two or more matings had larger litter sizes than gilts receiving only one mating, but this effect didn't hold for sows, a result consistent with those reported by O'Grady, et al.¹⁰ and Gooneratne, et al.¹¹ The cause of the observed differences in litter sizes between gilts and sows in response to mating frequency is not known. Our observations that a third mating was not associated with a significant increase in any of the fertility or litter size parameters measured contrasts with observations

Figure 5



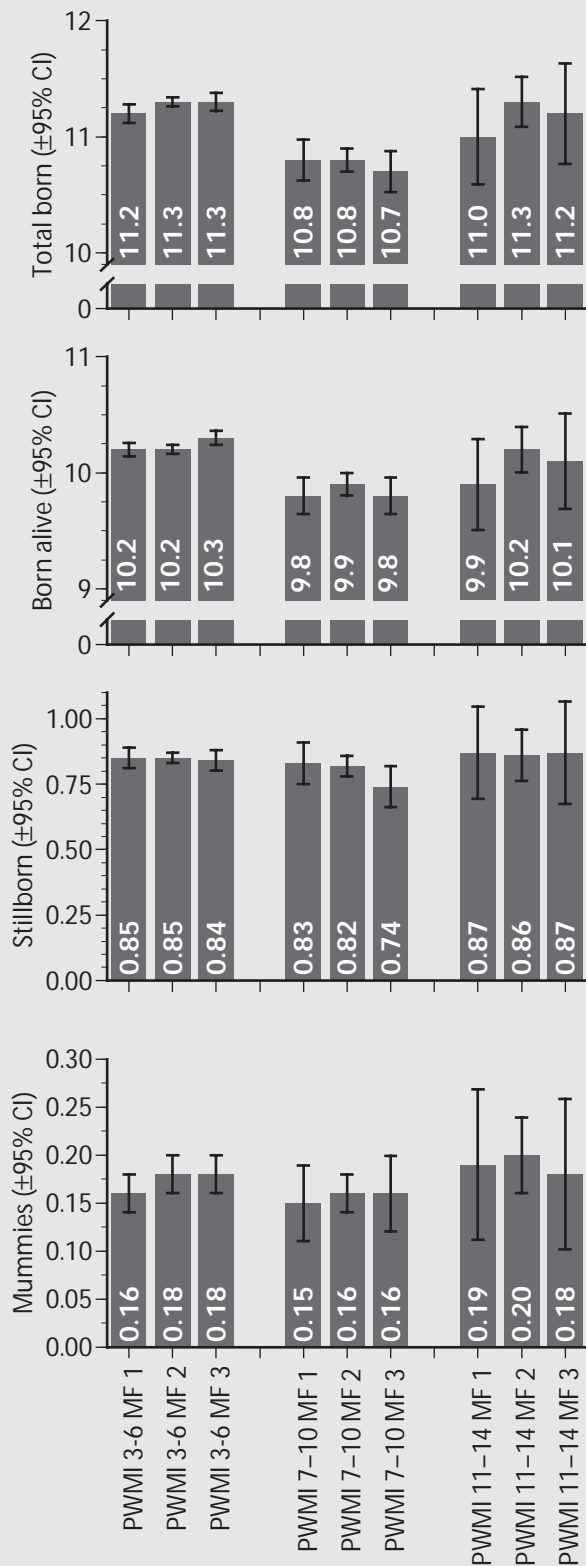
Least-squares means for litter size of females having different mating frequency

Differences ($P < .001$) in total born and live born pigs were detected only in gilts between mating frequency 1 and 2 and between mating frequency 1 and 3

reported by Reed⁶ and Tilton and Cole.⁵

Our observation that PWMI was associated with litter size is consistent with results observed in previous studies.^{7,13} However, our failure to

Figure 6



Least-squares means for litter sizes of sows having different mating frequency by previous weaning-to-mating interval (PWMI)

Sows with 7–10 d of PWMI had fewer ($P < .003$) total born and liveborn pigs compared with those with 3–6 d and 11–14 d of PWMI.

detect an interaction between PWMI and MF on litter size and fertility suggests that it may not be necessary for producers to consider PWMI when determining MF for their herds.

Our observation of a seasonal effect in this study is consistent with observations in previous studies.¹⁵

The major limitation of this observational study is that some of the females that received only one service may have originally been assigned to double or triple matings, but due to a short length of estrus during the service period, the target frequency could not be met. Thus, measures of reproductive performance in this study are likely confounded by duration of estrus. In a recent prospective study with a completely randomized design and natural service,¹² 15.3% of gilts and 4.5% of sows assigned to double matings were mated only once, as were 5.8% of gilts and 4.0% of sows assigned to triple matings. In most cases, females failed to receive the assigned number of matings because they refused to stand for mating after the first mating. These females may have started estrus a number of hours prior to estrus detection, or the duration of their estrus may have been relatively shorter than those females that received the assigned number of breedings. Slijkhuis and Schneijdenberg¹⁴ reported that sows with longer standing heats had higher farrowing rates and larger litter size than sows with shorter standing heats.

Implications

- Litter sizes in sows did not improve with double versus single matings, although fertility rates were improved in sows that received two versus one matings.
- No improvement in litter sizes and adjusted farrowing rates were observed in triple-mated females compared with double-mated females.
- Previous weaning-to-mating intervals do not appear to be a factor requiring consideration when determining mating frequency for sows.

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