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Short communication

# Abortion occurrence, repeatability and factors associated with abortions in female pigs in commercial herds

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ABSTRACT

Abortion occurrences disturb the projected production volume and increase non-productive days of female pigs. The objectives of the present study were (1) to define abortion occurrences including abortion rate and abortion risk, (2) to examine risk factors that were associated with abortions, (3) to determine repeatability of abortions and (4) to compare reproductive performance between aborting and non-aborting re-serviced female pigs. Datasets included 122,935 lifetime performance records and 630,363 mating performance records of females in 125 herds between 2008 and 2013 in Spain, Portugal and Italy. Annualized abortion rate was defined as the number of abortion records divided by the sum of the reproductive herd life days × 365 days × 100. Abortion risk per service was defined as the number of abortion records divided by the number of service records × 100. Generalized linear models with random herd effect were applied to the data. Annualized abortion rate ( ± SE) and abortion risk per service were 3.0 ± 0.05 and 1.2 ± 0.01%, respectively. Factors for an increased abortion risk per service were parity 0 or parity 5 or higher, re-servicing, servicing in July and August, delivering stillborn fetuses in a previous litter and having prolonged weaning-to-first-mating interval (WMI; $P < 0.05$). Gilts (parity 0) and sows in parity 5 or higher had 0.3% higher abortion risk than parity 1 sows ($P < 0.05$). Re-serviced females had 0.5% higher abortion risk than first-serviced females ($P < 0.05$). Females serviced in July and August had 0.4–0.5% higher abortion risk than those serviced in March and April ($P < 0.05$). Sows that had previously delivered stillborn fetuses subsequently had 0.1% higher abortion risk than those that had no stillborn fetuses ($P < 0.05$). Sows mated 7 days or more after weaning had 0.2% higher abortion risk than those mated 0–6 days after weaning ($P < 0.05$). Of the 7187 females that had aborted once, 4.1% experienced a second abortion in the same or a later parity. The repeatability of abortions was estimated to be 24.3–24.4%. Females that were reserviced after aborting had 0.6 lower total number of piglets born than re-serviced females that had not aborted ($P < 0.05$). However, there was no difference in farrowing rate or WMI between aborting and non-aborting re-serviced females ($P \geq 0.11$). It is recommended that producers closely monitor female pigs at risk of having an abortion in order to reduce non-productive female days.



## 1. Introduction

Reproductive failure, including abortion, is the major reason for culling of female pigs in commercial breeding herds (Engblom et al., 2007). Abortions in females cause economic losses in breeding herds, because abortion occurrences disturb the projected production volume, increase non-productive days of female pigs and decrease herd productivity. In Brazil and Thailand, 1.6–1.7% of serviced females in herds have aborted (Vargas et al., 2009; Tummaruk et al., 2010). Higher risks of abortions have been reported for serviced females in summer and autumn on a Spanish farm (3.11–3.25%, Domínguez et al. (1996)) and for re-serviced females (2.7%, Vargas et al. (2009)). Another study reported no difference in percentages of aborted females between parity groups (Tummaruk et al., 2010). However, few studies have examined other possible risk factors for abortions such as weaning-to-first-mating interval (WMI) and lactation length which are factors related to reduced swine fertility (Bertoldo et al., 2012).

Abortion occurrences (%) in commercial breeding herds are practically calculated by using service records of females as the denominator. Very few reports have calculated the abortion rate (incidence rate) using pig days as the denominator. However, the incidence rate is an accurate measurement of abortion occurrence in commercial herds because it takes account of a pig's herd life

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days, which can vary significantly in commercial herds (Friis and Sellers, 2003).

In addition, repeatability of abortions has not been examined extensively, although a Brazilian study did report that females re-serviced after abortion had relatively higher abortion risk than those re-serviced after return-to-estrus without abortion (6.5% vs. 2.7%, Vargas et al. (2009)). Furthermore, few studies have compared subsequent reproductive performance between aborting and non-aborting re-serviced females, even though a study showed that re-serviced females had 39% lower farrowing rate and 0.9 fewer piglets born alive than first-serviced females (Takai and Koketsu, 2007). Therefore, the objectives of this study using data from commercial breeding herds were (1) to define abortion occurrences including abortion rate and abortion risk, (2) to examine factors associated with abortions, (3) to determine repeatability of abortions and (4) to compare reproductive performance between aborting and non-aborting re-serviced females.

## 2. Materials and methods

### 2.1. Herds

A consultancy firm (PigCHAMP Pro Europa S.L. Segovia, Spain) has requested all client producers to mail them their data files since 1998. Of the 160 client farms in the designated countries, 125 (78% of the 160 farms) agreed for their farm data to be sued for research purposes. These herds were 98 Spanish herds, 23 Portuguese herds and 4 Italian herds. The herds use natural or mechanical ventilation in their farrowing, breeding and gestation barns. Females in the studied herds were mainly crossbred pigs between Landrace and Large White, which were either purchased replacement gilts from breeding companies, or were replacement gilts home-produced through internal multiplication programs. Lactation and gestation diets are formulated using cereals (barley, wheat and corn) and soybean meal. All the herds use artificial insemination; double or triple inseminations of females during an estrous period are recommended. All the 125 farms routinely performed pregnancy detection by 35 days after servicing. In the software, producers were required to choose one primary reason for farrowing failure from seven possible choices: natural abortion, induced abortion, return to service, pregnancy check negative, fail to farrow, culling and death or euthanasia. The dates of farrowing failure were also recorded by the farm workers.

### 2.2. Definitions

Abortion in the present study was defined as the natural termination of the pregnancy and subsequent expulsion of all conceptuses from day 35 to day 108 after first-mating date. The start and end dates for the abortion definition were determined as follows: day 35 was the date when pregnancy was confirmed by the pregnancy detection practices on the 125 participating farms. Day 108 was selected because fetus lung maturation is not complete until after this date (Almond et al., 2006). Induced abortion records were not treated as abortion records.

Annualized abortion rate (%) was defined as the number of abortion records divided by the sum of reproductive herd life days $\times$ 365 days $\times$ 100. Reproductive herd life days was defined as number of days from the date that the females were first-mated to removal. Abortion risk per service (%) was defined as the number of abortion records divided by the number of service records $\times$ 100.

A gilt was defined as a female pig that had entered a herd but had not farrowed, and a sow was defined as a female pig that had farrowed at least once. A mating was defined as any single insemination of a female during estrus, and a service included one or more mating events during estrus. A re-service was defined as more than one service event that occurred within the same parity. Herd size was calculated by averaging the initial and final female inventories during the study period. The change in herd size was calculated by (final female inventory-initial female inventory) divided by the initial female inventory $\times$ 100. Four herds with 500% or greater change in herd size (initial herd size: 1–20 sows) were not used for the calculation of the herd size change.

### 2.3. Reproductive performance data and exclusion criteria

Records of 128,535 females in the 125 herds were extracted from the PigCHAMP recording system. The data included mating performance records of females serviced from January 2008 to June 2013. The serviced females were entered into the herds between 2008 and 2010. So, the dataset included all the service records of the female pigs (entry cohorts) from their entry to removal. At the time the records were collected, 5600 (4.4%) of the females were still active and had not yet been removed from the herds; these records were excluded when lifetime records of removed female pigs were analyzed. The initial dataset contained 122,935 lifetime performance records and 715,939 mating performance records (including 70,406 re-service records).

Three separate datasets were created: Dataset 1 comprised lifetime records to investigate annualized abortion rate, Dataset 2 used service records to examine the associations between abortion risk per service and production factors, and Dataset 3 included only records of re-serviced females, to compare the reproductive performance at subsequent parity of aborting and non-aborting re-serviced females.

Sow records in Dataset 2 were excluded if they met any of the following criteria: total number of piglets born was either 0 or 26 pigs or more (471 records; Lundgren et al., 2010), lactation length was either 0–9 days or 42 days or more (6292 records; Hoving et al., 2011), number of pigs weaned was either three or fewer pigs (2351 records; Stevenson and Britt, 1981) or 17 or more pigs (the mean $+3 \times$ SD; 7834 records; Bloemhof et al., 2013), WMI was 36 days or more (6104 records; Hoving et al., 2011) and first-mating-to-farrowing-failure interval was 0–35 days (62,524 records). The following data in Dataset 2 were regarded as missing values; no records of gilt age at first-mating (55,355 records), and records showing gilt age at first-mating to be either 159 days or less or 401 days or more (20,378 records; Hoving et al., 2011). In Dataset 3, excluded data were records of re-serviced sows with total number of piglets born of either 0 or 26 pigs or more (64 records) or re-serviced sows with WMI of 36 days or more (583 records). Hence, Datasets 1, 2 and 3 comprised 122,935 lifetime records, 630,363 service records and 69,759 re-service records, respectively.

### 2.4. Statistical analysis

Descriptive statistics were performed in SAS version 9.3 (SAS Institute Inc., Cary, NC, USA). Multilevel generalized linear models were applied using MLwiN version 2.29 (University of Bristol, Bristol, UK), to account for the clustering of individual records within a female and clustering of females within a herd. Three statistical models were created. Model 1 was applied to Dataset 2 to analyze the abortion risk per service for both gilts and sows. Model 2 was also applied to dataset 2 to analyze the abortion risks for sows only. Model 3 was constructed using Dataset 3 to analyze reproductive performance (farrowing rate, total number of piglets born, number of piglets born alive and WMI) of re-serviced females.

The fixed effects examined in Models 1 and 2 were parity group (0–6 or higher), gilt age at first-mating, number of services group