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Climatic factors associated with abortion occurrences in Japanese commercial pig herds

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ABSTRACT

Objectives were to determine climatic and production factors associated with abortions in commercial swine herds and to compare the reproductive performances and culling patterns between aborting and non-aborting females that were re-inseminated. There were 309,427 service records analyzed for 56,375 females entered into 100 herds. Climate data were obtained from 21 weather stations located close to the herds. Mean daily average temperatures (Tavg) for the 21-day pre-mating period for each female were combined with the female's reproductive data. Generalized linear model assessments were conducted for abortion risk per service. Abortion risk per service (±SE) was 0.7 ± 0.06%, and mean value of Tavg (range) was 15.0 °C (−10.7 to 32.7 °C). Risk factors associated with an increased abortion risk per service were greater numbers of parities, delivering more stillbirth fetuses, greater mean Tavg for the 21-day pre-mating periods and re-servicing of females that did not get pregnant at the first servicing ($P < 0.05$). Abortion risk per service for parities 1–5 increased by 0.1–0.3% when the Tavg increased from 20 to 30 °C ($P < 0.05$), but there were no such associations for parities 0 and 6 or greater ($P \geq 0.37$). Aborting re-serviced females had 0.4 fewer pigs born alive than non-aborting re-serviced females ($P < 0.05$). Also, 64.6% of all aborting females were culled for reproductive failure, compared with only 23.4% of non-aborting females. In conclusion, producers should closely monitor females at greater risk of aborting and apply more advanced cooling systems.

1. Introduction

Abortion is one type of reproductive failure in sows in commercial herds (Engblom et al., 2007), which increases non-productive days of sows, and consequently decreases the reproductive performance of the herd (Almond et al., 2006). For example, 1.6–1.7% of mated females aborted in Brazil and Thailand herds (Vargas et al., 2009; Tummaruk et al., 2010). Abortions could occur due to pregnancy maintenance problems such as decreased concentrations of progesterone during gestation (Bertoldo et al., 2012) or infectious agents such as bacteria and viruses (Torremorrell, 2007).

Greater numbers of abortions occur during summer-to-autumn mating in swine herds in countries located in a continental climate zone such as Spain (Domínguez et al., 1996; Iida et al., 2014). Also, abortion risks for re-serviced females can be greater than that of first-serviced females that become pregnant to this breeding (Vargas et al., 2009). Meanwhile, a study showed that percentages of aborting females did not differ between parity groups (Tummaruk et al., 2010). Additionally, some studies have considered associations between climatic factors and sow reproductive performance in tropical conditions. For example, some studies in Thailand demonstrated that a greater ambient temperature and relative humidity were associated with a

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lesser reproductive performance of sows (Tummaruk et al., 2004; Suriyasomboon et al., 2006). There has, however, been no studies of quantification of associations between occurrences of abortions and climatic factors in subtropical climate zones, such as in Japan. Furthermore, no research has examined any interactions between climatic factors and other possible risk factors for abortions in the same model.

In addition, re-serviced females have a lesser farrowing rate and fewer total pigs born than first-serviced females that get pregnant as a result of the initial breeding (Takai and Koketsu, 2007; Vargas et al., 2009). Also, females that are re-serviced after abortion had a relatively greater abortion risk than re-serviced females which return to estrus without abortions (6.5% compared with 2.7%; Vargas et al., 2009). However, there have been few studies that have compared subsequent reproductive performance between aborting and non-aborting re-serviced females. Also, there has been no research comparing culling reasons between aborting and non-aborting females. Therefore, the objectives of the present study were (1) to determine risk factors associated with abortion occurrences, (2) to examine associations between climatic and production factors in relation to the risk of abortion, and (3) to compare the reproductive performance and the reasons for removal between aborting and non-aborting re-serviced females in Japanese commercial swine breeding herds.

2. Materials and methods

2.1. Herds

Pig producers in 102 Japanese breeding herds that use the PigCHAMP recording system (PigCHAMP, Ames, IA, USA) were requested to mail data files to Meiji University in 2011. By August 31, 2011, data files were received from all 102 breeding herds. Two of these herds were excluded from the present study because of production of only purebred pigs.

The remaining 100 commercial breeding herds were located between latitude 30 and 45°N and longitude 130 and 145°E. Natural or mechanical ventilation was used in the farrowing, breeding and gestation barns of these herds. The lactation and gestation diets were formulated using imported corn and soybean meal. Approximately 90% of these herds used artificial insemination. About 70% of the herds used a real-time ultrasonographic apparatus, and the remaining herds used an echo or Doppler ultrasonographic apparatus at approximately Day 30 of gestation. Females in the herds were mainly crossbreds between Landrace and Large White breeds that were either purchased replacement gilts from national or international breeding companies, or were replacement gilts produced on the farm through internal multiplication programs. The breeding stocks in the national breeding companies were originally imported from the USA or Europe during the latter half of the 20th century.

2.2. Climate data

Daily average temperatures (Tavg) and daily average relative humidity (ARH) data from 2005 to 2010 were downloaded from the climate statistics of 21 weather stations of the Japan Meteorological Agency (2014). The weather stations were located in the prefectural government office cities of the 21 prefecture districts where the herds were located. Based on the Köpper climate classification (Peel et al., 2007), the herds were located in either humid subtropical (95 herds) or humid continental climate zones (five herds). Mean (±SE) distance from each herd to the relevant weather station was 44.2 ± 2.71 km, ranging from 1 to 110 km. Mean values of Tavg and ARH for the 21-day pre-mating period of each female were calculated to combine with respective performance data from the PigCHAMP recording system. This 21-day period was chosen because a study has indicated that heat stress from 21 to 14 days before first insemination has the greatest effect on the farrowing rate (Bloemhof et al., 2013). Also, for first-serviced sows the 21-day pre-mating period includes both the weaning-to-first-mating interval (WMI) and a large part of the lactation period before service, during which heat stress could reduce feed intake, thus, may affect subsequent reproductive performance (Bloemhof et al., 2013). In addition, although there was no collection of room temperatures or relative humidity, findings from a previous study indicated changes in the air temperature of farrowing barns were closely related to changes in external air temperature (Odehnalová et al., 2008).

2.3. Definitions, data and exclusion criteria

Abortion was defined as the natural termination of the pregnancy with expulsion of all conceptuses from day 14 (week 2) to day 108 (week 16) after the first-insemination date (Almond et al., 2006). Week 0 after first mating was defined as day 0 of first mating, week 1 was from day 1 to 7 after first mating, week 2 was from day 8 to 14 after first mating, and so forth. The dates of occurrences of natural abortion were recorded by the farm workers. Abortion records with first-mating-to-abortion intervals of either less than 13 days or 109 days or longer were treated as records for non-aborting females because these records were not considered as abortions by the definition (171 records). Also, an abortion occurrence did not increase the number of parities for sows in the herd.

Annualized abortion rate (%) was defined as the number of abortion records divided by the sum of the reproductive herd life days × 365 days × 100. The variable, reproductive herd life days, was defined as the number of days from the date that the females were first mated to the date of removal from the herd. Abortion risk per service (%) was defined as the number of abortion records divided by the number of service records × 100. Abortion risk during the lifetime (%) of females was defined as the number of females aborting during their lifetime divided by the number of females removed from the herd by the time the data were collected × 100.

A gilt was defined as an individual that had entered a herd but had not farrowed, and a sow was defined as an animal that had farrowed at least once. A mating was defined as any single insemination during estrus, and a service was defined as one or more mating events during an estrous period. A re-service was defined as more than one service