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Assessment of reproductive performance in F_1 sows exposed to the porcine epidemic diarrhea virus at different periods of production stage on farms with different hygienic environments

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ABSTRACT

Porcine epidemic diarrhea (PED) occurred in Japan in 2013 after an interval of 7 years. The present study assessed individual productivity of sows exposed to PED virus at different periods of the production stage. The present study was performed at three commercial farms that had PED outbreak during the month of December 2013. Herd immunization was conducted for all gilts and sows. The production records were obtained for sows that were alive during the PED outbreak at each farm. The sows were categorized into six groups based on the period in which they were exposed to PED virus between days 0–30 (G1), 31–60 (G2), 61–90 (G3), or after 91 days of pregnancy (G4), during lactation (L), and after weaning (W). The control group was assigned based on the records before the period of PED outbreak (uninfected group). The number of sow's records obtained from farms A, B, and C were 1056, 1137, and 1035, respectively. Compared with the uninfected group, there was no reduction in the number of pigs born alive in the G1–G4 groups. Sows of the G4 and L groups, however, had 4–9 pigs fewer pigs weaned, and a 36%–77% greater pre-weaning mortality than the uninfected group ($P < 0.05$). There was no difference in farrowing rate and number of pigs born alive at subsequent parities among the sow groups. There were no interactions between sow groups and parity for sow productivity.

1. Introduction

Porcine epidemic diarrhea (PED) is caused by the PED virus, an enveloped and single-stranded RNA virus in the family Coronaviridae (Pensaert and DeBouck, 1978; Hofmann and Wyler, 1989; Stevenson et al., 2013). The PED is an emerging disease of pigs in a number of countries in North America, Europe, and Eastern Asia. The PED virus recently emerged as a global threat to the swine industry, because a number of epidemics were reported in many important swine-producing countries of North America, that were previously believed to be PED virus-free, and in Eastern Asia (Mole, 2013; Stevenson et al., 2013; Chen et al., 2014; Park et al., 2014; Hanke et al., 2015; Song et al., 2015; Weng et al., 2016). In Japan, PED was first reported in the 1990s, and only isolated and relatively unimportant outbreaks had been recorded (Sueyoshi et al., 1995). In October 2013 the first PED outbreak, however, was reported in Japan after an interval of 7 years (Diep et al., 2017; Sasaki et al., 2016). The PED virus isolated in this outbreak was

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different from the virus in the 1990s outbreaks, and had the greatest genetic similarity to USA isolates (Diep et al., 2015). The PED virus infection results in high morbidity and high mortality in suckling piglets, and decreased growth performance for those that survive infection (Alvarez et al., 2015; Huang et al., 2013). Few studies, however, have quantified the effect of an ongoing PED virus infection on reproductive performance during an epidemic. There is a need to quantify the effect of PED outbreak on sow productivity to accurately assess the importance of the current PED outbreak.

A previous study in Thailand reported that a relationship between PED infection and reproductive performance of sows was different among the stages of pregnancy: infection of PED virus during the first 30 days of pregnancy significantly decreased litter size, whereas no reduction in litter size was observed in sows in other stages when compared to non-infected control animals (Olanratmanee et al., 2010). Previously, there have been comparisons of productivity of Berkshire sows by different production stage, and found that sows infected in late pregnancy and during lactation had a greater pre-weaning mortality and a lower number of pigs weaned than the uninfected sows; however, there was no difference in productivity between sows infected at early or middle pregnancy and the uninfected sows (Furutani et al., 2017; Sasaki et al., 2017). A similar analysis should be performed in F_1 sows to illustrate the association of PED infection at different production stages with sow productivity. In particular, during the current epidemic in Japan, some farms performed herd immunization by feeding the pregnant sows with the feces and minced intestines of infected piglets. The effects of this immunization on productivity is still unknown.

Specific-pathogen-free (SPF) farms are the farms without the designated pathogen. SPF farms in Japan are defined as farms not having the following five diseases: toxoplasmosis, swine dysentery, Aujeszky disease, *M. hyopneumoniae*, and atrophic rhinitis (Japan SPF Swine Association, 2017). The SPF farms may have a greater biosecurity and hygienic environment than do ordinary farms. The effect of PED on reproductive performance might be different across different hygienic environments. Therefore, the objectives of the present study were to compare the reproductive performance of F_1 sows exposed to the PED virus at different periods of production stage on farms with different hygienic environments.

2. Materials and methods

2.1. Farm information related to PED outbreak

This study was conducted on three commercial farms in Kagoshima Prefecture, Japan. The farm information is described in Table 1. Farms A and B were farrow-to-wean farms, and farm C was a farrow-to-finish farm. The farms had a weekly batch-production system. Regarding herd health status, Farms A and B conducted typical management practices, whereas Farm C was a SPF farm as defined by the Japan SPF Swine Association (2017). The three farms conducted vaccinations against porcine reproductive and respiratory syndrome (PRRS) virus. On Farms A and B, the circulation of different PRRS virus strains was confirmed, whereas only the vaccine strain of PRRS virus was confirmed on Farm C. All breeding gilts and sows on these farms were F_1 crossbreeds (Landrace × Large White) that had been bred on these farms or purchased from the same domestic breeding company.

The first PED case in Kagoshima Prefecture was identified in December 2013, and the disease spread rapidly throughout the entire region. On these farms where the present study occurred, PED-like clinical signs were observed on December 30, 2013 on Farm A, January 1, 2014 on Farm B, and January 2, 2014 on Farm C. The first clinical signs observed in the farrowing barn of the three farms were diarrhea in the gilts and sows, and death of newborn piglets. The diagnosis of PED was immediately confirmed by reverse transcriptase polymerase chain reaction (RT-PCR) from collected samples of feces. Before this date, these three farms were confirmed

Table 1
Basic information of three farms used in the present study.

	Farm A	Farm B	Farm C
Farm information			
Herd size, pigs	1056	1137	1035
Production type	Farrow-to-wean	Farrow-to-wean	Farrow-to-finish
Group system	Weekly	Weekly	Weekly
Herd health strain	Ordinary	Ordinary	SPF[a]
PRRS virus status	Various strains were confirmed	Various strains were confirmed	Only vaccine strain was confirmed
Situation when PED occurred			
Date when PED occurred	December 30, 2013	January 1, 2014	January 2, 2014
Place which the first symptoms appeared	Farrowing barn	Farrowing barn	Farrowing barn
Distance from the closest PED-positive farm	5 m	5 m	4000 m
Feeding virus infected diets			
Date when performed	December 31, 2013	January 3, 2014	January 4, 2014
Materials	The feces of infected piglets, gilts and sows	The feces of infected pigs, gilts and sows	The feces of infected pigs, gilts and sows
Target	Sows in gestation barn	Sows in gestation barn	Sows in gestation barn
Date when PED was stable	Middle of April 2014	End of April 2014	Beginning of March 2014

[a] Specific-pathogen-free (SPF) farms in Japan are defined as farms not having five diseases including toxoplasmosis, swine dysentery, Aujeszky disease, *M. hyopneumoniae*, and atrophic rhinitis (Japan SPF Swine Association, 2017).