Short Communications

Prevention of PRRSV infection in large breeding herds using air filtration

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DUE to the potential for long-distance airborne transport of porcine reproductive and respiratory syndrome virus (PRRSV), the filtering of incoming air to pig facilities located in dense regions of production has been proposed as a means to reduce this risk (Dee and others 2009a, Pitkin and others 2009). Those investigators used a model of a pig production region to document the airborne transport of PRRSV to a distance of 4.7 km and to demonstrate the ability of air filtration to protect naive populations of pigs from airborne PRRSV for a period of one year.

In order to test this intervention in a commercial setting, a pilot study was conducted in seven large (greater than 3000 sows) breeding herds located in pig-dense regions of southern Minnesota and northern Iowa, USA. All seven herds had a history of annual PRRSV infections secondary to the introduction of new variants over the past four years, despite the use of industry-standard biosecurity practices for known routes of direct and indirect spread of the virus (Pitkin and others 2009). For the purpose of the present study, two of the seven herds (F-1 and F-2) were air filtered using technology described by Pitkin and others (2009), while the remaining five herds served as non-filtered controls (NF-1 to NF-5) (Table 1). Before filtration, the existing wild-type variant (PRRSV 1-18-2) had been eliminated from herds F-1 and F-2, resulting in PRRSV-negative status (Torremorell and others 2002). Filters were installed in the attic and both facilities used negative-pressure ventilation systems. F-1 used a total of 3660 EU 9 (MERV 16) filters, while F-2 used 1944 EU 8 (MERV 14) filters (Dee and others 2009b). These filters had been determined to be 95 per cent and 75 per cent efficient, respectively, at capturing particles greater than or equal to 0.3 µm in diameter.

Following installation of the filters in September 2008, PRRSV status was monitored across all the herds monthly for a 12-month period. During these visits, herds were assessed for clinical evidence of PRRS and production data were reviewed. In addition, blood samples were collected from 30 piglets from each herd at weaning and tested for the presence of PRRSV RNA using PCR (Egli and others 2001). If positive, the open reading frame (ORF) 5 region of the virus from the sample in question was nucleic acid sequenced (Murtaugh and others 1995) and compared with the farm-specific historical PRRSV database.

Due to the large number of pig farms surrounding the study herds and the high risk of indirect spread of the virus (Lager and others 2002), the authors attempted to determine whether filtered herds were being challenged by airborne PRRSV. Air samples were therefore collected daily directly outside the F-2 facility for six weeks from November to December 2008. Using a previously published method, a liquid cyclonic collector (Midwest MicroTek) was placed approximately 10 m outside the F-2 facility in accordance with the daily prevailing wind (Dee and others 2009a). For example, if winds contacting the F-2 facility originated from the north-west, the instrument was positioned to face directly into this wind while sampling. Over a 42-day sampling period, two air samples were collected each day; one from 6.00 to 8.00 Central Standard Time (CST) and another from 8.00 to 10.00 CST. While sampling, airborne particles entering the instrument's collection vessel were washed with 10 ml minimum essential medium supplemented with 3 per cent fetal calf serum (Difco). After sampling, a 5 ml aliquot was tested by PCR. To prevent contamination, study personnel changed gloves and sanitised the instrument between samplings (Dee and others 2009a, Pitkin and others 2009).

Throughout the 12-month study period, evidence of PRRSV infection was not detected clinically or diagnostically in the two filtered herds. In contrast, all of the non-filtered control herds experienced severe clinical episodes of PRRS. The ORF5 regions of PRRSV variants recovered from affected pigs during these episodes were 5 to 12 per cent heterologous to historical isolates (Table 2), indicating that all five herds had been infected with new viruses (Chang and others 2002). Seventy-three air samples were collected from F-2. Two samples were found to be positive for PRRSV RNA by PCR, and sequencing indicated the

TABLE 1: Characteristics of filtered (F) and non-filtered (NF) sow herds selected for the study

Herd	Number of sows	Sites within 4.7 km*	New infections in past four years†
F-1	3128	17	7
F-2	3240	9	4
NF-1	3232	5	4
NF-2	3210	10	5
NF-3	3669	8	4
NF-4	3553	10	3
NF-5	3680	6	3

* Number of growing pig sites located within 4.7 km of the study herds. These facilities were not sourced with pigs from the study herds
† Number of heterologous variants of porcine reproductive and respiratory syndrome virus (PRRSV) detected in herds over the four years before the start of the study. A heterologous variant was defined as a viral sequence differing by 2 per cent or more in its ORF5 region when compared with the previous variant recovered from the herd during its previous episode of PRRS

TABLE 2: Summary of the porcine reproductive and respiratory syndrome virus (PRRSV) status of filtered (F) and non-filtered (NF) herds during the 12-month study period

Herd	Status in September 2008	Status in August 2009	Date of new infection	Per cent heterology*
F-1	–	–	NA	NA
F-2	–	–	NA	NA
NF-1	+	+	May 2009	11
NF-2	+	+	July 2009	10
NF-3	+	+	July 2009	5
NF-4	+	+	April 2009	5
NF-5	+	+	May 2009	12

* Difference in the ORF5 region of the new variant that entered the herd during the 12-month study period compared with the PRRSV variant that was present when the study began
– Negative, + Positive, NA Not applicable

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presence of two distinct variants (PRRSV-184 and PRRSV 1-4-2). Based on a review of historical diagnostic data, these variants had not been recovered from previous disease episodes on either farm F-1 or F-2, and throughout the 12-month study period there was no evidence of entrance of either virus to either of these two farms.

In conclusion, although further assessment of air filtration is required, involving a larger number of farms over a longer period of time, the results from this pilot study suggest that farms in dense regions of pig production are at risk of PRRSV airborne challenge and that the filtering of incoming air is an effective means to protect susceptible populations under highly challenging conditions, such as the area employed in this study. Studies are currently underway to answer these questions.

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