

**Title:** An assessment of air filtration for reducing the risk of PRRSV infection in large breeding herds in swine dense regions – **NPB #09-209**

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### Industry summary

As the US swine industry moves towards regional control and elimination of PRRSV, a critical component is the ability to reduce the risk of the airborne spread of the virus between herds. Therefore, the filtering of incoming air has been proposed as a means to reduce this risk. To test this intervention, a study was conducted utilizing 10 treatment (filtered) herds and 26 (non-filtered) control herds over a 24-month period involving large breeding herds in swine dense regions. Throughout the study period eight of the treatment herds remained free of infection; however, two herds experienced clinical PRRS secondary to the introduction of a new variant of the virus from an external source determined to be contaminated transport in one case and a personnel biosecurity breach in the other. In contrast, 24 of 26 (92 percent) of control herds experienced severe clinical episodes of PRRS secondary to the introduction of new variants. These results indicate that air filtration is an effective means to reduce the risk of external PRRSV introduction to large breeding herds located in swine dense regions.

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**Keywords:** swine, PRRSV, airborne, transmission, filtration

## **Abstract**

The filtering of incoming air to has been proposed as a means to reduce the risk of porcine reproductive and respiratory syndrome virus (PRRSV) infection of at-risk populations of pigs. To test this intervention, a study was conducted utilizing 10 treatment (filtered) herds and 26 (non-filtered) control herds over a 24-month period involving large breeding herds in swine dense regions. Following installation of filters in the 10 treatment herds the PRRSV status was monitored for a 24-month period of time (September 2008-August 2010) across both groups. Throughout the study period eight of the treatment herds remained free of infection; however, two herds experienced clinical PRRS secondary to the introduction of a new variant of the virus from an external source determined to be contaminated transport in one case and a personnel biosecurity breach in the other. In contrast, 24 of 26 (92 percent) of control herds experienced severe clinical episodes of PRRS secondary to the introduction of new variants. Chi square analysis indicated that treatment herds were significantly less likely ( $p = 0.0001$ ) to become infected throughout the 24-month trial period when compared to control herds. These results indicate that air filtration is an effective means to reduce the risk of external PRRSV introduction to large breeding herds located in swine dense regions. Studies are currently underway to continue to assess the sustainability of air filtration and to calculate its cost: benefit.

## **Introduction**

The filtering of incoming air to has been proposed as a means to reduce the risk of porcine reproductive and respiratory syndrome virus (PRRSV) infection of at-risk populations of pigs (Pitkin and others 2009). To test this intervention, a pilot study was recently conducted in large breeding herds located in swine-dense regions of southern Minnesota and northern Iowa (Spronk and others 2010). While it generated very promising results, it was limited by both sample size and study period since it involved only two filtered (treatment) and 5 non-filtered (control) herds and was only conducted over a one-year period of time. Therefore, to further test this intervention a larger study was conducted utilizing 10 treatment herds and 26 control herds over a 24-month period.

## **Objectives**

To evaluate the ability of air filtration to reduce external PRRSV introduction in large breeding herds in swine-dense regions

## **Materials and methods.**

**Selection criteria:** To participate in this study, a candidate herd was required to have a breeding herd inventory of 2400 sows or more. In addition, candidate herds needed to be surrounded by four or more growing pig sites within a 4.7 km radius and candidate herds could not supply pigs to any of these surrounding sites (Dee and others 2009a). Finally, candidate herds had to have experienced a minimum of three external PRRSV infections over the past four years despite the use of industry standard biosecurity practices previously validated against known routes of direct and indirect spread of the virus (Pitkin and others 2009).

**Filtration system:** All treatment herds utilized published air filtration technologies in conjunction with negative pressure ventilation systems (Dee and others 2009b). Filters were installed in the attic and/or as a filter bank placed externally to the facility's evaporative cooling pad (Spronk and others 2010). Five of the 10 treatment herds used EU 9 (MERV 16) filters while the other five used EU 8 (MERV 14) filters (Dee and others 2009b). These filters had been determined to be 95 percent and 75 percent efficient respectively, at capturing particles of greater than or equal to 0.3 microns in diameter. A summary of characteristics of study herds is provided in Table 1.

**Monitoring procedure:** Following installation of filters in the 10 treatment herds the PRRSV status was monitored for a 24-month period of time (September 2008-August 2010) across both groups. On a monthly basis, treatment and control herds were assessed for clinical evidence of PRRS and production data reviewed. In addition, blood samples were collected from 30 piglets at weaning and tested for the presence of PRRSV RNA using polymerase chain reaction (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 to historical PRRSV isolates in the farm-specific database.

## **Results.**

Throughout the study period eight of the treatment herds remained free of infection; however, two herds experienced clinical PRRS secondary to the introduction of a new variant of the virus from an external source. In contrast, 24 of 26 (92 percent) of control herds experienced severe clinical episodes of PRRS secondary to the introduction of new variants. Of these 24 farms, 13 (54 percent) were infected one time during the study period, nine (38 percent) were infected twice with different PRRSV variants and two (eight percent) were infected three times, again with different variants. These conclusions were based on the fact that the open reading frame 5 regions of the PRRSV variants recovered from affected pigs during these clinical episodes were eight to 14 percent heterologous when compared to historical farm-specific isolates, proving that all new viruses originated from external sources (Chang and others 2002). Chi square analysis indicated that treatment herds were significantly less likely ( $p = 0.0001$ ) to become infected throughout the 24-month trial period when compared to control herds.

## **Discussion**

The results of this study indicate that the filtration of incoming air is a means to reduce the risk of external PRRSV introduction to susceptible populations of pigs in swine-dense regions of production. In addition, based on a larger sample size and a longer study period, these results support pilot project data compiled by Spronk (Spronk and others 2010). In regards to the two infected treatment herds, investigations revealed that the source of the new variant for herd one was an improperly cleaned transport vehicle based on the recovery of PRRSV from the floor surfaces of trucks used to transport pigs to the farm (Dee and others 2002). The virus was found to be 100 percent homologous to the PRRSV recovered at a later date from affected animals within the herd. In regards to herd two, security camera recordings documented multiple biosecurity breaches by farm personnel and external vendors, including the improper disinfection of incoming supplies, the

introduction of unauthorized tools that had been previously used on another swine farm earlier that day, and the failure of personnel to comply with the herd's shower-in policy (Otake and others 2002, Dee and others 2004). In addition, inspection of the filtration systems in both cases revealed no physical damage of filters or evidence of external air leaks, along with the absence of published climactic conditions associated with airborne spread of PRRSV during the estimated time of the infection in either herd (Dee and others 2010).

In closing, producers and veterinarians now have a proven means to reduce the spread of PRRSV between farms via the airborne route. Studies are currently underway to continue to assess the sustainability of air filtration and to calculate its cost: benefit. Finally, the fact that the two treatment herds became infected via means which were unrelated to airborne transmission emphasizes the need for a comprehensive plan of biosecurity that targets all known routes of PRRSV introduction to herds.

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**Table 1: Characteristics of study herds**

<b>Herd<sup>1</sup></b>	<b>#<sup>2</sup></b>	<b># infected<sup>3</sup></b>	<b>BHI<sup>4</sup></b>	<b># sites/4.7 km<sup>5</sup></b>	<b># infections/4 years<sup>6</sup></b>
Treatments	10	2	3163	8	5
Controls	26	24	3238	8	5

**Key**

- 1: Herds designated as treatments are filtered while those designated as controls are non-filtered.
- 2: Number of herds in each study group.
- 3: Number of herds in each group which experienced an external PRRSV infection during the 24-month study period.
- 4: Mean breeding herd inventory across study groups.
- 5: Mean number of pig sites located within 4.7 km of the study herds.
- 6: Mean number of PRRSV infections secondary to the introduction of heterologous variants in herds over the four years prior to initiation of the study.