Sponsors

We thank the following sponsors:

Platinum
Bayer Animal Health
National Pork Board
Pfizer Animal Health

Silver
Boehringer Ingelheim Vetmedica, Inc.

Bronze
Cargill
Merck Animal Health
Novartis Animal Health

Copper
AgStar Financial Services
Elanco Animal Health
IDEXX
Newport Laboratories
PIC USA
PRRS CAP

University of Minnesota Institutional Partners
College of Veterinary Medicine
University of Minnesota Extension
College of Food, Agriculture and Natural Resources Sciences

Formatting
Tina Smith Graphics
www.tinasmithgraphics.com

CD-ROM
David Brown
www.davidhbrown.us

Logo Design
Ruth Cronje, and Jan Swanson;
based on the original design by Dr. Robert Dunlop

Evaluation study of interventions for reducing the risk of PRRSV introduction into filtered farms via retrograde air movement (back-drafting) through idle fans

Carmen Alonso; Satoshi Otake; Peter Davies; Scott Dee

Department of Veterinary Population Medicine, College of Veterinary Medicine, University of Minnesota, St. Paul, Minnesota

Introduction

The economic impact of porcine reproductive and respiratory syndrome virus (PRRSV) has been recognized worldwide.[1] Airborne transmission of the virus is an important route of spread between farms.[2] As a means to reduce this risk, Pitkin and others demonstrated the ability of air filtration to prevent the introduction of PRRSV-contaminated bioaerosols to susceptible populations.[3] Based on these data, several North American production systems have implemented air filtration systems.[4] While preliminary results are promising, a major risk that currently exists in filtered herds under negative pressure ventilation is the retrograde movement of PRRSV-contaminated bioaerosols through non-filtered points i.e. inactive fans.[5] To reduce this risk, several interventions have been developed but not validated. Therefore, the objectives of this study are to demonstrate that the risk of PRRSV-contaminated aerosols entering a facility via retrograde air is a true risk; to titrate the minimum air speed necessary to introduce PRRSV-contaminated aerosols via retrograde air; and to validate commercially available interventions that have been designed to prevent this risk.

Materials and methods

The study was conducted at the UMN SDEC production region model.[3] Using an existing 25 m² facility (void of pigs and ventilated via negative pressure) one of the two 30 cm fans was intentionally stopped while the other continued to operate. All other inlets to the facility were closed resulting in a static pressure of 572 Pa. This arrangement created the potential for retrograde air movement into the facility via the inactive fan. This fan, located on the south end of the building was equipped with a standard plastic shutter commonly encountered in commercial swine farms. The operational fan was located at the north end of the facility.

In order to measure the air speed of the retrograde air through the idle fan needed to transfer PRRSV (retrograde air titration), a common plastic shutter was challenged at various fan stages using 10 replicates of different PRRSV concentrations each. The measurements of retrograde air speeds and static pressures were collected for each fan stage.

For the treatment evaluation aspect of the study, treatments included the standard plastic shutter (A), a plastic shutter plus a canvas cover (B), a nylon windsock (C), an aluminum shutter plus a windsock (D) and, a double shutter system involving both a set of aluminum and plastic shutters (E). All 5 treatments were challenged with 4 different aerosolized concentrations of PRRSV ranging from 1 to 7 logs of the virus in a liter which were generated using a cold-fog mister[6] located on the exterior of the facility 45cm from the inactive fan. To determine whether aerosolized PRRSV could penetrate the treatments, a cyclonic collector was placed inside the facility[3,4] 45cm from the inactive fan. Ten replicates were conducted per treatment, each replicate was 1 minute in length and air samples were tested for the presence of RNA PRRSV by PCR.

Results

The titration of the retrograde air showed that an air speed of 0.76 m/s was needed to move PRRSV-contaminated aerosols through the common plastic shutter.

Results for the treatment challenge are summarized in Table 1. Retrograde movement of air in association with the introduction of PRRSV to the interior of the facility was observed during the assessment of treatment A (plastic shutter alone) and B (plastic shutter plus canvas cover). PRRSV introduction to the facility was not observed following the application of the other interventions.

Discussion

The results of this study suggest that a real risk of PRRSV entry may exists when there is a minimum retrograde air speed of 0.76 m/s through temporally inactive fans in filtered farms. As well this study suggests that some commonly found interventions do not offer complete protection against retrograde air movement and the risk of aerosolized PRRSV entry. In contrast, interventions such as double shutter systems or shutter plus windsock combinations appear to eliminate this risk. Therefore, a program to minimize the risk of retrograde movement of air into filtered facilities appears to be critical for reducing the airborne risk of PRRSV.

Table 1: Performance of treatments according to challenge dose

PRRSV concentration	A	B	C	D	E
$10^1 TCID_{50}/L$	10/10	4/10*	0/10*	0/10*	0/10*
$10^3 TCID_{50}/L$	10/10	3/10*	0/10*	0/10*	0/10*
$10^5 TCID_{50}/L$	9/10	3/10*	0/10*	0/10*	0/10*
$10^7 TCID_{50}/L$	10/10	6/10	0/10*	0/10*	0/10*

A-E: Treatments

* significantly different when compared to plastic shutter alone ($P < 0.05$)

Acknowledgements

This study was funded by the National Pork Board.

References

1. Neumann et al., (2005) JAVMA 227:385–392.
2. Dee et al., (2009) Vet Res 40:39.
3. Pitkin et al. (2009) Vet Microbiol 136, 1–7.
4. Dee et al., (2010) Virus Res 154, 177–184.
5. Feder (2008). AASV Filtration Pre-Conf, 15–16.
6. Dee et al., (2009) Vet Microbiol 138,106–113.