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An update of SDEC-related research efforts on the aerobiology and biosecurity of porcine reproductive and respiratory syndrome virus and *Mycoplasma hyopneumoniae*

S. Dee[1]; S. Otake[1]; A. Pitkin[1]; S. Oliviera[1]; J. Deen[1]; P. Davies[1]; G. Spronk[2]; D. Schwerin[2]; D. Reicks[3]; P. Yeske[3]; L. Schulz[3]; P. Ruen[4]; S. Pohl[5]

[1]Swine Disease Eradication Center, University of Minnesota, [2]Pipestone Veterinary Clinic, [3]Swine Vet Center, [4]Fairmont Veterinary Clinic, 5: South Dakota State University

Introduction

Since its emergence in the late 1980s, porcine reproductive and respiratory syndrome virus (PRRSV) has been an economically significant pathogen of pigs throughout the world.[1,2] In conjunction with *Mycoplasma hyopneumoniae*, PRRSV has contributed to development of the porcine respiratory disease complex, resulting in poor growth rates, elevated mortality and increased cost of production.[3] Early work by several groups indicated that elimination of PRRSV from endemically infected farms could be accomplished through several methods, including test and removal, herd closure and whole herd depopulation-repopulation.[4,5] Unfortunately, due to the problem of external virus introduction (area spread), farms located in swine-dense regions of production were unsuccessful in remaining free of infection.[6] Efforts to characterize the components of area spread of PRRSV at the University of Minnesota Swine Disease Eradication Center (SDEC) have focused on documenting the indirect routes of PRRSV transport and transmission along with the development and testing of biosecurity protocols to reduce risk. Initial studies demonstrated the ability of fomites, personnel, transport and insects to serve as vehicles for the mechanical movement of virus from infected to naïve populations of pigs.[7-14] In conjunction with these data, biosecurity protocols to reduce these risk factors were identified.[7,8,15-17] Unfortunately, despite rapid adaptation of this information at the farm level, the issue of area spread of PRRSV still plagued producers and practitioners', leading to the observation from the field that airborne transmission of the virus was playing an important role in the spread of the virus between farms, particularly in swine-dense regions.

This observation brought about a focused period of assessment of the ability of PRRSV to be transported and transmitted by aerosols. Previous efforts to reproduce this event under controlled laboratory and field conditions had frustrated many investigators, leading many to doubt of its realism.[18-20] However, work by Cho et al demonstrated a significant difference in the frequency of aerosol shedding and transmission by isolates of varying pathogenicity, resulting in the conclusion that airborne spread may be influenced by strain.[21,22] Specifically, a recently emerged, highly virulent isolate (MN-184) was compared to a standard isolate of low virulence (MN-30100). In summary, pigs infected with PRRSV MN-184 demonstrated significantly higher titers of virus in blood, tissues, nasal and oral secretions/excretions and aerosols.[21,22] In addition, while airborne spread of PRRSV MN-184 was reproduced over a distance of 1 m, similar results could not be reproduced using PRRSV MN-30100. Armed with this new information, investigations in the ability of air filtration to reduce the risk of airborne transmission of PRRSV were initiated, beginning with a trip to Brittany, France to study positive pressure-based HEPA filtration ventilation systems (Dee, personal experience 2004). While the observations were clinically interesting, it was quickly realized that the system could not be applied to the US swine industry due to cost and a predominance of negative pressure-based ventilation systems. Therefore, a series of laboratory-based investigations were conducted to identify low-cost alternatives,[23-25] leading to the selection of a MERV-16 filter (Camfill-Far) which was 95% efficient at removing particles ≥ 0.3 microns in diameter.

The next phase of investigation involved the use of the production region model, a model which attempted to represent an area or a "neighborhood" of pork production in a swine-dense region.[26] This model utilized a source population (300 head, 25-120 kg) population of pigs experimentally inoculated with PRRSV MN-184 housed in a mechanically ventilated building to serve as a source of airborne contaminants for the other farms in the "neighborhood". These other (n = 3) sites housed PRRSV-naïve pigs and served as treatments (filtered) and controls (non-filtered). Basically, over a 361-day study period the model demonstrated the presence of infectious PRRSV in

bioaerosols excreted into the environment by the source population, the ability of the virus to travel 120m by aerosols, and that naïve populations raised in filtered facilities could remain free of infection while populations raised in non-filtered facilities could not.[26]

At this time, the study is being repeated over a 2-year period of time, involving a co-infection PRRSV MN-184 and *Mycoplasma hyopneumoniae* (M hyo) strain 232, the assessment of lower-efficiency filters including MERV-14 and antimicrobial products, and the recording of real-time meteorological data during periods of airborne spread of both agents. In addition, additional studies have been conducted to assess the ability of both agents to be transported by aerosols over long distances.[27] These results are summarized below. In addition, based on these data along with the highly successful application of air filtration to AI centers, an assessment of the efficacy of air filtration to large sow units in swine dense regions is underway along with protocols devised to measure external risk factors for virus entry into these units. To enhance the success of this venture, the SDEC partnered with 3 premier swine clinics in the US (Pipestone Veterinary Clinic, Swine Vet Center and Fairmont Veterinary Clinic) along with an experienced agricultural engineer (Dr. Steve Pohl). Preliminary data from all 4 of these studies will be presented at the Leman Conference and are summarized in these proceedings as follows:

Project 1: Update on production region model of PRRSV and *Mycoplasma hyopneumoniae* transmission and biosecurity

The objectives of this study were to validate the results obtained from the previous 1-year study[26] by repeating the project over a longer period of time (2 years) utilizing a co-infection of PRRSV MN-184 and *Mycoplasma hyopneumoniae,* collecting real-time weather data and evaluating alternative filtration systems.

Materials and methods

This study incorporated four different facilities to represent four different farms in an endemically PRRSV-infected region. The infected population was located in the middle of the region with the three other facilities of different biosecurity levels; High-1 (MERV 16 or MERV 14: 95% DOP @ 0.3 micron air filtration system, along with insect, fomite, personnel and transport protocols), High-2 (antimicrobial air filtration system), and Medium (matching protocols except for filtration), surrounding it at equal distances of 120 meters. The study was planned to run for two years and have 26 replicates each of 4 weeks in duration. PRRSV MN-184[3] and *M. hyo* 232 were used to inoculate the pigs in the infected population source on day 0. Serum and nasal swabs were collected weekly from all pigs in the three recipient facilities in order to monitor the infection status of PRRSV and *M. hyo* in each population. Air was collected using a cyclonic collector capable of collecting 400 L of air per minute. Inspired air was washed throughout the sampling period with MEM plus 3% FCS. Sampling was conducted daily at 7 AM in each facility for a 30-minute period of time and air samples were tested for PRRSV and *M. hyo* by PCR. Finally, in order to assess the potential role of season on the airborne spread of both agents, on-site weather station (HOBO, Onset Corporation) was placed on the study site and real-time weather data were collected at 5-minute intervals.

Preliminary results

As of this writing, 22 replicates have been completed (Nov 07-July 09). No transport or transmission of PRRSV and *M. hyo* has been detected in High-1 facility (MERV 16 or 14-filteration). PRRSV and *M. hyo* airborne transport was detected in approximately 10% of air samples collected in the High-2 facility (Antimicrobial-filtration); however, no transmission of either agent to susceptible pig populations has been detected at any time. In Medium facility (non-filtered control), PRRSV and *M. hyo* transport and transmission was detected in multiple replicates (PRRSV transmission: 10 out of 22 replicates, *M. hyo* transmission: 9 out of 22 replicates). Consistent weather patterns were observed during days in which PRRSV RNA or *M hyo* DNA were detected. Detailed information will be presented at the conference.

Project 2: Evidence of long distance airborne transport of PRRSV and *Mycoplasma hyopneumoniae* (27)

Introduction

The purpose of this study is to provide evidence of long distance airborne transport of PRRSV and *M hyo* and to identify meteorological conditions associated with these events. The study was based on the hypothesis that long distance airborne transport of both agents can occur given the correct conditions.

Materials and methods

To assess the potential for long distance airborne spread of PRRSV and *M hyo*, a designated sampling area within 44 km^2 region around the SDEC site was plotted, consisting of 16 sampling points radiating outward from the source facility in the 4 cardinal directions: north (N), south (S), east (E) and west (W) and the 4 intermediate directions: northwest (NW), northeast (NE), southwest (SW) and

southeast (SE). Over the course of the 50-day study period, it was planned to collect air samples at distances of 1.7 and 3.3 km to the N, S, E and W of the source population facility, and at distances of 2.6 and 4.7 km to the NE, NW, SE and SW of the facility. The sampling points furthest from the source population facility (3.3 km and 4.7 km) were designated as "A" points, i.e. NW-A, while the points closer to the facility (1.7 km and 2.6 km) were designated as "B" points, i.e. NW-B. The distance from the source population facility to each sampling point was determined using the odometer of a designated farm vehicle and each point was marked with a fuchsia-colored plastic flag. Daily air samples were collected at a pre-determined direction from the source population facility in accordance with the direction of the predominant wind. This decision was based on the findings of Pitkin and others, who had previously determined that the odds of detecting a PRRSV-positive bioaerosol were 6.4 times higher when the predominant wind was moving from a facility which housed a PRRSV-infected population.[26] Therefore, if the predominant wind direction was from the NW, personnel would collect air samples "downwind" from the source population facility at the SE-A and SE-B sampling points. Wind direction was determined using the wind vane on a HOBO weather station (Onset Computer Corporation, Bourne, MA, USA) which was located on the study site, adjacent to the source population facility.

In regards to the collection of air samples, using sample size tables **and** an estimated prevalence of ≥ 2% PRRSV or *M hyo*-positive air samples with a power of.8 and alpha of.05, a sample size of 149 samples across the A distances and 149 samples across the B distances was calculated, resulting in a total of 298 long distance air samples. For the collection of air samples, a liquid cyclonic collector capable of capturing 400 L of air per minute was utilized (Midwest MicroTek, Brookings, South Dakota, USA).[26] Previous assessment of the instrument's sensitivity for detecting PRRSV in aerosols had been determined it to be 1×10^1 $TCID_{50}$/mL.[26] Throughout the study, the daily collection period was from 5:00 AM CST to 10:00 AM CST with an interval of 30 minutes per sample.[26] It was planned to collect 3 to 4 samples over the period of 5:00 to 7:00 AM CST at the designated A point and 3 to 4 samples from 7:15 to 9:15 AM CST at the designated B sampling point each day.

To transport the instrument to the designated sampling points, the cyclonic collector was placed in the cab of a farm vehicle (Chevrolet S-10 1987), elevated 25 cm off the seat by means of a wooden box and powered using the vehicle's battery. The dimensions of the vehicle cab were 1.5 m H × 2 m W × 1 m L, allowing it to act as a chamber to capture incoming air. Upon arrival to the sampling point, the vehicle was parked with the passenger side of the cab facing directly into the predominant wind. To serve as an air inlet, the passenger window was opened in its entirety while the driver side window was opened approximately 5 cm to act as an air outlet. During the 30-minute sampling process, airborne particles entering the collection vessel of the cyclonic collector were washed with 10 mL of minimum essential medium (MEM) supplemented with 3% fetal calf serum (Difco, Detroit, Michigan, USA).After each 30 minute sample was collected, a 5-mL aliquot of MEM was removed and stored on ice until testing was completed each day. To minimize the risk of contamination, study personnel changed gloves and sanitized the collector between air samples.[26] The instrument was sprayed with alkyl dimethly benzyl ammonium chloride (Lysol, Reckitt Benckiser, Wayne, NJ, USA), the collection vessel rinsed with fresh MEM and dried with disposable paper towels and swabbed using sterile Dacron swabs (Fisher Scientific, Hanover Park, IL, USA).[25] Swabs were stored in sterile plastic tubes (Falcon, Becton Dickinson, Franklin Park, NJ, USA) containing MEM supplemented with 3% fetal calf serum and stored on ice. Upon completion of long distance air sampling, a single 30-minute air sample from the source population was collected from 9:30 to 10:00 AM CST each day. For collection of this sample, the cyclonic collector was placed outside of the source population facility, 1 m from a designated exhaust fan.[26] All samples were stored at -20˚C until tested

Prior to the initiation of the study, a series of controls were conducted to validate the ability of the collection method to successfully recover aerosolized PRRSV (positive controls) and to demonstrate a lack of mechanical contamination during the sampling process (negative controls). For positive controls, artificial PRRSV aerosols of varying concentrations were developed using a modified live PRRS virus vaccine (Ingel Vac MLV, Boehringer-Ingelheim Vetmedica, St. Joseph, MO, USA). One hundred mL aliquots of vaccine virus were diluted 10-fold in 1L aliquots of sterile saline to produce concentrations ranging from 1×10^1 $TCID_{50}$/L to 1×10^7 $TCID_{50}$/L. Prior to the initiation of the study, the quantity of virus in each dilution was validated via virus titration. To aerosolize the virus into the vehicle cab, the tank of a cold fog mister (Hurricane ULV/mister, Curtis Dyna-Fog Ltd. Westfield, IN, USA) was filled with 1 L of each concentration, beginning with 1×10^1 $TCID_{50}$. The mister was set at a flow rate of 200 mL/minute and was placed 1 m off the ground and 1 m from the vehicle with the nozzle set at a 45˚ angle. A 5-minute release period was utilized, resulting in the aerosolizing of 1 L of diluted vaccine. Following release of the aerosolized virus, the cyclonic collector was allowed to run for 30 minutes and a 5-mL aliquot was removed from the collection vessel and stored at -20˚ C. For the purpose of negative controls, the process was repeated 7 times using saline only.

Throughout the study, daily sanitation controls were conducted to validate the absence of residual genetic material in the vehicle and the cyclonic collector. At the conclusion of daily sampling, the entire cab of the vehicle was disinfected with alkyl dimethly benzyl ammonium chloride spray and wiped dry with disposable paper towels. Swabs were then collected from surfaces within the cab including the seat (1 swab), steering wheel (1 swab), accelerator (1 swab), brake (1 swab) and dashboard (1 swab), pooled 5:1 and tested as a single sample. The windows of the cab were closed and the vehicle was stored overnight in the garage on the study site. Then, each day prior to sampling, a 30-minute air sample from the vehicle cab was collected to validate the absence of residual PRRSV or *M hyo* in the cab. During this process, the windows of the cab remained closed and the vehicle remained in the garage. Finally, in between every 30-minute air sample collected during the daily sampling period, the aforementioned cab surfaces and the cyclonic collector were sanitized and swabbed. At the end of each day's sampling period, the vehicle was returned to the garage, disinfected and allowed to sit overnight with its windows closed in preparation for the next day's sampling. The cyclonic collector was then sanitized one final time and stored in the house on the study site overnight. These processes were repeated on a daily basis throughout the 50-day study period and all air samples and swabs were stored at -20˚C. All air and swab samples were tested for PRRSV RNA and M hyo DNA by PCR. The presence of infectious PRRSV in positive samples was confirmed by swine bioassay, the quantity of infectious PRRSV in positive samples determined using virus titration and the OFR 5 region was sequenced. The P146 gene of positive M hyo samples were sequenced as well.

Meteorological data were collected using an on-site HOBO weather station (Onset Computer Corporation, Bourne, MA, USA). Data were logged at 5 minute intervals. The parameters collected included temperature (C˚), relative humidity (%), two measures of sunlight intensity (watts/m^2) and photons (µmol/m^2/s) within the photosynthetic active radiation spectrum of 400-700 nm, barometric pressure (hectoPascals), precipitation (mm of rainfall), wind direction (degrees), wind velocity (m/s) and wind gusts (m/s). This latter parameter was defined as the highest 3-second wind speed recorded during each 5-minute logging interval. To provide a numerical value for wind direction, the 4 cardinal and 4 intermediate directions were assigned a range as follows: north (mean=0˚, range=346˚to 14˚), northeast (mean=45˚, range=15˚ to 75˚), east (mean=90˚, range=76˚ to 104˚), southeast (mean=135˚, range=105˚ to 165˚), south (mean=180˚, range=166˚ to 195˚), southwest (mean=225˚, range=196˚ to 255˚), west (mean=270˚, range=256˚ to 284˚) and northwest (mean=315˚, range=285˚ to 345˚).

The days of air sample collection were classified as those days having a positive sample found or as those having a negative sample. The association between PRRSV-positive days and *M hyo*-positive days at the source population level was tested for significance using a Chi square test. The association of a pathogen-positive air sample collected at the source population exhaust fan and at long distance sampling points was tested for significance using a Fisher's exact test. Climatic data were averaged over the time of collection on each day and compared with the detection status. Mean wind direction was not analyzed as sampling was based on wind direction. The association between wind direction and PRRSV-positive days and *M hyo*-positive days was tested using a Chi-square test. Mean values of meteorological variables on PRRSV-positive days or *M hyo*-positive days were compared to values observed on PRRSV-negative days and *M hyo*-negative days using two sample T-tests (with unequal variances).

Results

A total of 356 air samples were collected across the 50-day study period, representing approximately 180 hours of sampling time. Fifty of the 356 air samples were collected from the source population exhaust fan and 17 (34%) were PCR positive for PRRSV RNA while 18 (36%) were positive for *M hyo* DNA. Of the 17 samples that contained PRRSV RNA, the mean quantity of infectious virus was 3.9×10^5 $TCID_{50}$/mL, with a median of 6.0×10^3 $TCID_{50}$/mL and a range of 5.2×10^1 $TCID_{50}$/mL to 2.9×10^6 $TCID_{50}$/mL. A total of 306 long distance air samples were collected (153 samples at point A and B) and 4 (1.3%) were found to be PRRSV PCR-positive. All 4 samples were obtained on different days: October 5 (6:30 to 7:00 AM), October 6 (6:00 to 6:30 AM), October 22 (5:30 to 6:00 AM) and November 11 (7:00 to 7:30 AM) and all were detected at the NW collection point at a distance of 4.7 km from the source population. All 4 samples contained infectious PRRSV with the quantity of virus ranging from 3.0×10^1 $TCID_{50}$/mL, 4.1×10^1 $TCID_{50}$/mL, 5.2×10^2 $TCID_{50}$/mL and 7.8×10^2 $TCID_{50}$/mL, respectively. All 4 samples contained infectious PRRSV as validated by swine bioassay and no infection was observed in the sham-inoculated control. Phylogenetic analysis of the ORF 5 nucleic acid sequences obtained from a subset of samples including sera from experimentally inoculated pigs, exhausted air from the source population facility and the 4 samples obtained at the NW collection points were classified as MN-184, based on a high degree of homology ($\geq$ 98.8%) with the PRRSV MN-184 isolate that was used to inoculate the animals on day 0 of the study.

Of the 306 long distance air samples collected, 6 (1.9%) were *M hyo* PCR-positive. All were recovered on different days: October 5 (7:30 to 8:00 AM), October 11 (7:30

to 8:00 AM), October 22 (5:00 to 5:30 AM), October 23 (5:30 to 6:00 AM), November 3 (8:00 to 8:30 AM) and November 6 (6:00 to 6:30 AM). Four were obtained at the NW sampling point; with 2 samples collected at the 2.3 km sampling point and 2 samples at the 4.7 km sampling point. Of the remaining 2 samples, one sample was obtained at the SE sampling point and the other at the SW sampling point, both points being 4.7 km from the source. Phylogenetic analysis of these samples along with positive samples recovered from exhausted air from the source population indicated a high degree (99.9%) of homology to the original *M hyo* 232 strain used to inoculate the pigs at the onset of the study.

The positive control air samples were PCR-positive across all 7 concentrations tested while all 7 negative control air samples (saline only) were PCR-negative. Air samples collected from the enclosed cab of the vehicle prior to daily sampling were PRRSV and *M hyo* PCR-negative (n = 50 samples per agent tested) as were all pools of swabs collected from the cab surfaces (n = 50 samples per agent tested). In addition, all

swabs collected from the cab surfaces between the collection of air samples were PRRSV and *M hyo* PCR-negative (n = 306 samples per agent tested). Finally, all swabs collected from the sanitized cyclonic collector between the collection of air samples were PRRSV and *M hyo* PCR-negative as well (n= 306 per agent tested).

Across the 50-day study period, the origin (directionality) of the winds during the daily sampling periods was as follows: north (2 days, 4%), northeast (2 days, 4%), northwest (21 days, 42%), southeast (15 days, 30%), south (2 days, 4%), southwest (3 days, 6%), east (4 days, 8%) and west (1 day, 2%). The association between PRRSV-positive days and *M hyo*-positive days at the level of the source population exhaust fan was significant when tested using a Chi square test ($P < 0.0001$). The association between the presence of PRRSV in an air sample collected from the exhaust fan and at the 4.7 km long distance sampling point was significant ($P = 0.01$) using a Fisher's exact test. In contrast, the association between *M hyo*-positive days at the exhaust fan and *M hyo*-positive days at long distance sampling points (2.3 km and 4.7 km combined) was not significant ($P = 0.18$). PRRSV-positive days only occurred when there was a mean NW wind direction (+/- 20 degrees). This association was significant when tested using Chi-square analysis ($P = 0.04$); however, only 4 of the 6 *M hyo*-positive days occurred when the wind direction was NW ($P = 0.39$). Other weather variables were not as strongly associated, but there were associations that need further study.

Conclusions

This is the first report to provide evidence of long distance airborne transport of PRRSV and *Mycoplasma hyopneumoniae*. This study provides swine veterinarians and producers with proof that long distance airborne transport of economically significant pathogens of swine is possible and identifies meteorological conditions significantly associated with these events. Whether either agent could have been transported beyond the 4.7 km sampling point cannot be answered at this time; however, future studies involving longer sampling distances and extended sampling periods may help to collect a larger number of samples and answer this question, as well as facilitate a more in-depth analysis of associated meteorological conditions.

Project 3: An evaluation of the efficacy of air filtration in large sow herds located in swine dense regions

Introduction

The specific aim of this study is to evaluate the efficacy of air filtration in large sow herds in swine-dense regions and calculation of its cost: benefit using data from filtered and non-filtered herds.

Materials and methods

Participant herds will meet the following criteria:

Filtered (treatment) herd: A PRRSV-negative sow herd with an inventory of ≥ 2400 sows to which a validated air filtration system has been installed. Filtered herds will have historically received naïve gilt replacements and semen from naïve AI centers and have practiced a scientifically validated program of biosecurity for indirect routes of PRRSV transmission including personnel/fomite entry, transport sanitation, and insect control. Participant herds will have experienced ≥ 3 new PRRSV introductions over the past 4 years and these viruses will have been analyzed by ORF 5 sequencing. Herds will be located in areas with ≥ 4 pig sites within a 2-mile radius and these neighboring sites will have experienced PRRSV infection and clinical disease 3-6 months prior to the initiation of the study. The herd will complete a Risk Assessment for Breeding Herds at the initiation and termination of the study.

Unfiltered (control) herd: A sow herd which meets the criteria defined for filtered herds, but which has not installed an air filtration system. Control herds can be either PRRSV-negative or positive. To assess the impact of air filtration, we will measure: (1) differences in the frequency of virus introduction across treatment and control herd. This will be defined as the detection of a PRRSV that differs by 2% in the ORF 5 region from previous viruses found in the herd. The new virus may

Advanced Knowledge

or may not be associated with clinical disease. (2) cost of implementation of air filtration systems on large sow herds. (3) differences in performance and profitability between treatment and control herds following analysis of production and financial data.

Filtered and control herds will be monitored for PRRSV introductions using a standardized testing program, i.e., collection of blood samples from 30 weaned piglets every month with qRT-PCR testing of pools of 5. Neighboring herds within 2 miles of study herds will be monitored in a similar manner on a monthly basis using a random sample of 30 pigs across all age groups. Oral fluid sampling will be conducted concurrently in these herds and compared to the current standard. In the event of a positive sample, PRRSV ORF 5 will be sequenced and compared to historical sequences. In addition, a biosecurity audit will be conducted to evaluate compliance with existing biosecurity protocols. Weather data will be collected for a period of ≥ 7 days prior to the estimated date of infection for the purpose of identifying specific meteorological parameters previously determined to be significant risk factors for the presence of PRRSV in air.

For logistical reasons (number of filtered herds limited by producer participation) and uncertainty in the prediction of the likelihood of future disease outbreaks, conventional sample size calculation is not practicable. Based on previous data the expert opinion of practicing veterinarians, the annual risk of a new virus being introduced into an unfiltered sow herd in a hog dense area was estimated to be in the range of 0.25 to 0.6. This equates to probabilities ranging from 0.68 to 0.97 that an unfiltered herd would become infected with a new virus over a 4-year period. Based on these assumptions, a sample size of 6 filtered herds and 18 unfiltered herds was determined to be adequate (power = 0.8) to demonstrate a statistically significant difference (one-tailed alpha = 0.05) in risk (cumulative incidence of virus introduction) between the filtered and unfiltered herds. One tail significance testing is appropriate as there is no biologically plausible mechanism by which air filtration could increase the risk of PRRS introduction.

Preliminary results

As of this writing, 1 year of the study has been completed. No evidence of external virus introduction has been detected in filtered farms while 51% of the non-filtered control farms have become infected with new isolates. Further details will be presented at the conference.

Preliminary conclusions

At this time, air filtration appears to be an effective means to reduce the risk of the introduction of PRRSV to large sow herds in swine-dense regions. Further testing is necessary to assess the sustainability of this intervention under these extremely challenging conditions.

Project 4: Establishing a standard operation procedure (SOP) to assess external risk factors of PRRSV transmission in commercial sow farms

Introduction

The objective of this study was to establish a SOP (standard operating protocol) to evaluate external risk factors for PRRSV introduction to filtered sow farms, to assess if sites are being challenged, the source of the external challenge and whether biosecurity practices can effectively reduce risk.

Materials and methods

The SOP was first piloted in a 3200 sow herd in southern Minnesota for a 40-day period during the month of December 2008 and January 2009. On each sampling day, the following samples were collected: (1) swabs from the hands, clothes and boots of farm personnel (prior to and after showering), (2) all fomites that entered the facility (lunch boxes, semen bags, etc), (3) all double-door entry areas (entry room, shower room, fumigation room, weaning pig load out, and dead pig/sow load out rooms). In addition, a daily air sample was collected outside of the facility. All the samples were tested for PRRSV by PCRThe study was then repeated in this farm as well as in 3 other sow farms of similar size. All farms utilized either MERV 14 or MERV 16 filtration. The sampling period for the 4-farm study consisted of 10 consecutive days on each site.

Preliminary results

In the pilot farm, a single positive air sample was detected. Sequencing of this sample indicated evidence of an isolate not present within the sow herd. Further testing of the population at risk indicated that this isolate never successfully penetrated the herd. All other samples were negative. In the 4-farm study, the sampling SOP detected the presence of PRRSV RNA in external samples in 2 out of the 4 farms. In both farms, positive air samples were identified that contained evidence of a heterogonous wild-type virus. In addition in one of these farms, PRRSV was detected n a swab sample collected from entry room floor in one of the farms and was found to be identical to the virus detected from the air coming to this farm. All swab samples from personnel and fomites were negative for PRRSV in all farms. Detail information will be presented in the meeting.

Preliminary discussion

The sampling methods and SOP we established in this study appeared to be effective in evaluating external risk factors of PRRSV transmission in each sow farm we tested. Assessing the risk factors of PRRSV transmission

in commercial sow farm by the scientific measurement on real-time basis is of great value for veterinarians/producers to improve their biosecurity practices in the farms.

Thoughts at the time…

In conclusion, it is the vision of this team of SDEC researchers and Minnesota veterinarians that air filtration will prove to an essential intervention strategy to reduce the risk of area spread of airborne pathogens in regions of dense swine production. In the 20+ years since the emergence of PRRSV, the ability to consistently produce a non-infected weaned pig has never been possible. As this is an essential element of sustainable PRRSV control and eventually wide-spread elimination. Therefore, we foresee a rapid adaption of air filtration to existing buildings along with the new construction of facilities being designed with air filtration in mind. Time will tell if this vision is accurate; however, we are confident that data from our research efforts can and will be successfully applied in the field and that early adopters of this technology will experience the greatest economic return on investment in the shortest period of time.

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