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SDEC Partners Research Update

Project Update: Model to estimate PRRSV introduction in negative pressure filtered farms

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Background

- Producers invest in air filtration to protect farms from airborne porcine reproductive and respiratory syndrome virus (PRRSV).
- PRRSV introduction in filtered farms can still happen if there is significant air leakage in the buildings, and/or if filters have insufficient particulate matter removal efficiency.

Objective

- To assess the relative importance of PRRS virus introduction through the filters and farm leaks, and estimate in-barn PRRS virus concentrations using a deterministic mathematical model

Materials and methods

- A deterministic model was developed with adjustable inputs including barn size, number of filters, filter removal efficiency, ventilation flow, fan capacity, leakage rate, particle size distribution and viral concentration among some of the most important inputs.
- Scenarios were evaluated for a 3,000 sow herd with 0.5 filters (2 ft2) per sow and conditions of winter air flow (20 cubic feet minute (cfm)/sow), summer air flow (200 cfm/sow) and filter particle removal efficiencies of MERV 14 and MERV 16 filters, and a MERV14 used filter with removal particle efficiency of 45%, 81% and 90% for particle size ranges of 0.3-1, 1-3 and > 3 microns, respectively.
- For most comparisons total virus concentration per cubic meter (RNA virus copies/m3) were assumed to be 100 distributed as follows, 10%, 10%, and 80% for particle size ranges of 0.3-1, 1-3 and > 3 microns, respectively. The effect of virus concentration distribution was then compared to a distribution of 33%, 33% and 33%.

Results:

• In-barn virus concentration (virus RNA copies/m3 of air) was higher in winter compared to summer (Table 1), although the total amount of virus entering a barn (virus RNA per second) was higher in summer.

• Virus introduction through leakage was more important in MERV 16 than MERV 14 filters, and in the winter for both, MERV 14 and 16, filters (Table 1).

• Virus distribution by particle size affected the total amount of virus introduced through the filter (MERV 14) but not through the leaks (Table 2).

• Decreased efficiency in used filters, increased the risk of virus introduction through the filter but not through leakage (results not shown).

	Winter		Summer	
	Filter	Leak	Filter	Leak
MERV 14	10.5 (55)	8.6 (45)	11.3 (84.5)	2.1 (15.5)
MERV 16	4.5 (33)	9.3 (67)	4.9 (65.6)	2.6 (34.4)

Table 1: In-barn estimated PRRSV RNA copies concentration (RNA copies/m3) and % of the total shown within brackets by season and type of MERV filter.

	Distribution 10,10,80		Distribution 33, 33, 33	
Particle size	Filter	Leak	Filter	Leak
0.3 – 1.0	2.29 (72.7)	0.86 (27.3)	7.54 (72.6)	2.84 (27.4)
1.0 – 3.0	0.91 (51.4)	0.86 (48.6)	3.02 (51.5)	2.84 (48.5)
> 3.0	7.31 (51.5)	6.88 (48.5)	3.02 (51.5)	2.84 (48.5)
TOTAL	**10.51**	**8.6**	**13.57**	**8.51**

Table 2: In barn estimated PRRSV RNA copies concentration (RNA copies/m3) using a MERV 14 filter and % of the total shown within brackets by virus distribution based on particle size of 0.3-1, 1-3 and >3 microns

Conclusions and Implications:

- Under the conditions tested, filter efficiency, outside barn virus concentration, and virus distribution by particle size were the variables that affected the in-barn virus concentration the most.
- Higher in-barn virus concentrations were obtained with lower ventilation and higher leakage rates.
- Although the model was parameterized using data from field measurements and experimental studies, it may not fully represent field conditions. The model helps identify high risk areas and areas for which data is limited or that need further research.

For more information or access to the model please contact Montse Torremorell (torr0033@umn.edu).