

# Investigating the use of aerosol disinfection during the weaner period on APP prevalence in fogged grower/finisher pigs

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## Introduction

In shelters with 200 pigs per airspace APP is rarely seen, run the same source pigs in larger continuous flow groups and chronic and acute APP will be a problem. Respiratory disease severity is proportional to the square of the number of pigs in an airspace. 400 pigs per airspace is the tipping point where respiratory disease is considered to be a potential problem. Sheds with 2,000 to 4,000 pigs have 25 to 100 times the risk of respiratory disease including APP as a 400 place pig shed.

APP is difficult to control in large farrow to finish CF systems as the sow progeny become seronegative around 12 weeks' old and gilt progeny as young as 8 weeks old. In large groups there are pigs excreting APP bacteria and others becoming seronegative and highly susceptible to APP infection. APP can remain dormant in a herd with a number of tonsillar carriers- at some crisis point (poor ventilation, stocking rate, too many ages in an airspace, chilling, out of feed event) the pigs can go from carrier to clinical case in less than a day precipitating an outbreak. Once the environment is loaded with APP bacteria the disease continues. Vaccines are of limited value in preventing pleurisy but if given with adequate frequency can markedly reduce mortality. Autogenous vaccines are usually monovalent while off the shelf vaccines can be trivalent. Usually the more strains included the lower the antigen titre and efficacy for a specific strain.

Aerosol disinfection for APP control has been attempted with some success over 30 years in at least 3 countries but has not been widely implemented. In the USA it was noted by Dean (pers com) as being useful for APP but not for other respiratory disease. The advent of Strict AIAO multi-site systems in USA reduced the incidence and severity of APP. Recently clients have embarked on small scale aerosol disinfection to attempt to control APP with the goal to alleviate the high cost of comprehensive vaccination, lack of effective antibiotics and the inability to convert larger older grower facilities with a mix of room and shed sizes to true AIAO. If 10-30% of the pigs will not fit true AIAO and 70-90% do then an amelioration that does not rely on high frequency vaccination or high antibiotic input is required for those 10-30% CF pigs.

Anecdotal evidence at Rivalea using fogging during the grower/finisher phase has shown promising results in terms of mortality and pleurisy levels. Current fogging in the Mod 1 Big Dutchman facility uses a fixed high pressure low micron system. Foggers to be used in the weaner sheds will be low pressure low micron pedestal fans.

## Materials and Methods

### *Animals and treatments*

Three thousand, eight hundred and twenty nine male and female pigs (Large White x Landrace, PrimeGro™ Genetics) were selected at weaning and housed in one of four commercial weaner rooms at Module 1. Pigs were weaned the week of Monday 11<sup>th</sup> August 2014, with the animals having been born at one of four farrowing sites. Each weaner room was filled to ensure a similar distribution of sex and birth site across the four rooms with pigs of the same sex and birth site housed together in individual pens. Each weaner room was similar in overall footprint, but not identical in internal design such as pen layout. The number of pigs weaned into each room was almost identical (954-959 pigs per room). Two weaner rooms were made up of pens accommodating 64 pigs/ pen while the other two weaner rooms had double the amount of pens but accommodated 32 pigs/pen.

Weaner rooms were designated as ‘fogged’ or ‘unfogged’, with one small pen room and one large pen room allocated to each treatment group. Fogged weaner rooms were subject to aerosol disinfection from entry to 9 weeks of age. This fogging was carried out using pedestal misting fans with timers set to fog for 30 mins every two hours. Three fans per room were utilised during the initial 2.5 weeks post weaning and four fans per room thereafter. The disinfectant used was Viragard at a rate of 1:1000

At 9 weeks of age pigs were moved to grower/finisher accommodation hereafter referred to as the Big Dutchman facility. Pigs of the same birth module and sex were once again housed in the same pen together, with on average 40.6 pigs per pen. Pigs from the two fogged weaner rooms were accommodated at one end of the Big Dutchman facility, while the unfogged weaners were housed at the alternate end of the shed. The finisher facility was naturally ventilated with automatic side curtains and the pen partially slatted. The entire Big Dutchman facility was aerosol disinfected with a fixed Scolexia high pressure system. The disinfectant used was once again Viragard at a rate of 1:1000, with the system running at a pressure of 750 psi and 10 micron nozzels. The misting system ran for 10 mins every 2 hours outside of staff working hours, and then on a restricted schedule during the day due to OH&S requirements (From 10am – 10 mins on, 10 mins off, 10 mins on; from 1pm – 10 mins on, 10 mins off, 10 mins on; during staff breaks).

Pigs were offered *ad libitum* access to commercial weaner, grower and finisher diets for the duration of the study. All pigs received the ACE APP vaccine at 8/10/12/16 weeks of age. All male pigs were administered the priming Improvac vaccination at 13 weeks of age and the secondary vaccination at 17 weeks of age. All animals had *ad libitum* access to water via nipple drinkers for the entire experimental period.

### *Measures*

Commencement weights were recorded on a subset of pens in each weaner room during the first week post weaning representing pigs from each of the four birth sites. Fan output was recorded daily as measured by the amount required to top up the fan storage tank each day. A coughing and sneezing assessment was undertaken weekly throughout the weaner period and conducted on a room basis. In each room, 128 pigs (two groups of 64 in differing areas of the shed) were scored for the number of coughs and sneezes during a three minute window. The protocol of waking the pigs and immediately starting the scoring was strictly adhered to and the same pens of pigs were scored each week.

Pen weights in the grower/finisher facility were recorded at entry (9 weeks of age) and again pre-sale (21 weeks of age). Feed intake and feed efficiency were calculated on a pen basis over this test period. All deaths and removals were recorded and taken into account when calculating feed intake and feed efficiency by the adjustment of the number of days that pigs were on trial. All mortalities and destructions from 9 weeks of age onwards underwent a basic post mortem investigation to document the following – pneumonia with APP, pneumonia without APP, enteritis and colitis.

Coughing and sneezing assessments continued in the Big Dutchman facility, with 5 pens per treatment group scored on a monthly basis (same pens each month). The pens were randomly chosen and represented a mix of sexes and birth modules within each fogging treatment group. Additional cough/sneezing assessments were undertaken during APP outbreaks as deemed necessary.

Pigs were slaughtered in a commercial abattoir at the conclusion of the experimental period. Individual hot standard carcass weight (HSCW), fat depth at the P2 site (65mm from the midline, obtained using a Hennessy Chong) and loin depth were measured on all carcasses. Dressing percentage was calculated from the final live weight and carcass weight measures and analysed on a pen basis.

### *Statistical analyses*

Data were analysed using an analysis of variance (ANOVA) using the pen as the experimental unit for all analyses. All analyses were performed using Genstat 10<sup>th</sup> Edition (Payne *et al.* 2005).



## Results

### *Weaner fogging efficacy:*

Prior to the start of the experiment each pedestal fan was tested to ensure a similar rate of delivery of a set volume of water. This was very much a trial and error process with the same settings not delivering similar volumes across all fans. Once in the weaner sheds, the output from each pedestal fan was measured indirectly by recording the amount added to the storage reserve on a daily basis. On average, each fan dispersed 17.6L per day into the weaner shed, with average daily outputs varying between fans quite substantially (Table 1). The initial study design included two fans per weaner shed, but this was increased to three given the distance of the mist spread. After the initial two weeks, it was clear that the daily output between fans was relatively inconsistent and a fourth fan was added to each shed to cover this variability. These fans are primarily manufactured for domestic use and are not certified to deliver a required volume per hour. Water quality is also a key consideration for use of such fogging equipment, with the use of dam water at this farm likely having an impact on output per fan over the test period.

Table 1. Average fogging output (l/day) per fan measured on a weekly basis throughout the weaner period.

Shed	Fan	Week 1	Week 2	Week 3	Week 4	Week 5
6	134	24.00	15.14	13.29	17.43	8.00
	136	18.50	11.71	13.29	10.86	11.00
	155	18.50	15.43	16.29	16.00	16.00
	29			32.00	16.29	19.00
<b>Average Shed 6</b>		<b>20.33</b>	<b>14.10</b>	<b>15.09</b>	<b>15.14</b>	<b>13.50</b>

<b>7</b>	135	18.50	21.14	21.33	22.57	31.00
	139	22.25	19.43	18.86	25.14	28.00
	178	19.50	13.14	9.71	8.25	6.00
	28			32.00	20.43	24.00
<b>Average Shed 7</b>		<b>20.08</b>	<b>17.90</b>	<b>17.14</b>	<b>20.40</b>	<b>22.25</b>

*Weaner performance:*

Average piglet weights were measured on a subset of pigs within the first week of placement, with the animals in the control weaner rooms an average of 7.5 kg, and those in the fogged rooms 7.7 kg (P=0.42, sed 0.36).

An overview of the deaths, destructions and removals for each weaner room is displayed in Table 2. There were no differences in total mortality/removals between the two treatment groups (control 2.5 %, fogged 2.7 %,  $\chi^2=0.27$ , P=0.60). Multiple temperature loggers were placed in each weaner room during the first week post weaning, located on the fences or feed bins as close to pig level without being accessible to the pigs. Figure 1 shows the average shed temperature fluctuations during this period. The data clearly shows sheds 7 and 8 maintained higher ambient temperatures than sheds 5 and 6 throughout this period, due primarily to better insulation in these sheds. From this data, it may have been expected that sheds 5 and 6 would have had the worst mortality/removal rate but shed 5 performed well.

Coughing and sneezing assessments were undertaken in each weaner shed once a week. Average coughing and sneezing scores for 128 pigs over 3 minutes are displayed in Table 3 on a shed basis, with the treatment means by week in Table 4. Main effects of fogging treatment were not statistically significant for cough scores (control 3.1 and fogged 2.6, P=0.33, sed 0.40), nor did they differ significantly for sneeze scores (control

Table 2. Deaths, removals and destructions per weaner room

	Control sheds		Fogged Sheds	
	Shed 5	Shed 8	Shed 6	Shed 7
<b>Destructions:</b>				
Arthritis	1			
Feet and legs		6	5	1
Haemolytic E.coli		1		
Meningitis	2	1	2	
Lame	1			
Pot Belly				1
Unthrifty	2	13	15	12
<b>Deaths:</b>				
Scours	1			
Sudden deaths	10	7	9	5
<b>Removals:</b>				
Head stuck in feeder			1	
Unthrifty		1		
<b>TOTAL</b>	17/959 (1.8%)	29/957 (3.0%)	32/959 (3.3%)	19/954 (2.0%)

Table 3. Weekly coughing/sneezing assessment per shed

	Average Cough Score				Average Sneeze Score			
	Control sheds		Fogged Sheds		Control sheds		Fogged Sheds	
	Shed 5	Shed 8	Shed 6	Shed 7	Shed 5	Shed 8	Shed 6	Shed 7
Week 1	0.5	5.5	3.5	5	22	16.5	26.5	29.5
Week 2	3	2.5	3.5	3	18	36.5	13.5	23
Week 3	4.5	3	1.5	3.5	20.5	21	21.5	14.5
Week 4	4	2	0.5	0.5	14.5	16.5	11	10.5

Table 4. Treatment means by week for the coughing/ sneezing assessment

	Week					Significance		
	Week 1	Week 2	Week 3	Week 4	SED	Fogging	Week	Fogging x week
<b>Coughs</b>								
<b>Control</b>	3.0	2.8	3.8	3.0	0.40	0.33	0.16	0.12
<b>Fogged</b>	4.3	3.3	2.5	0.5				
<b>Sneeze</b>								
<b>Control</b>	19.2	27.2	20.8	15.5	2.04	0.44	0.14	0.30
<b>Fogged</b>	28.0	18.2	18.0	10.8				

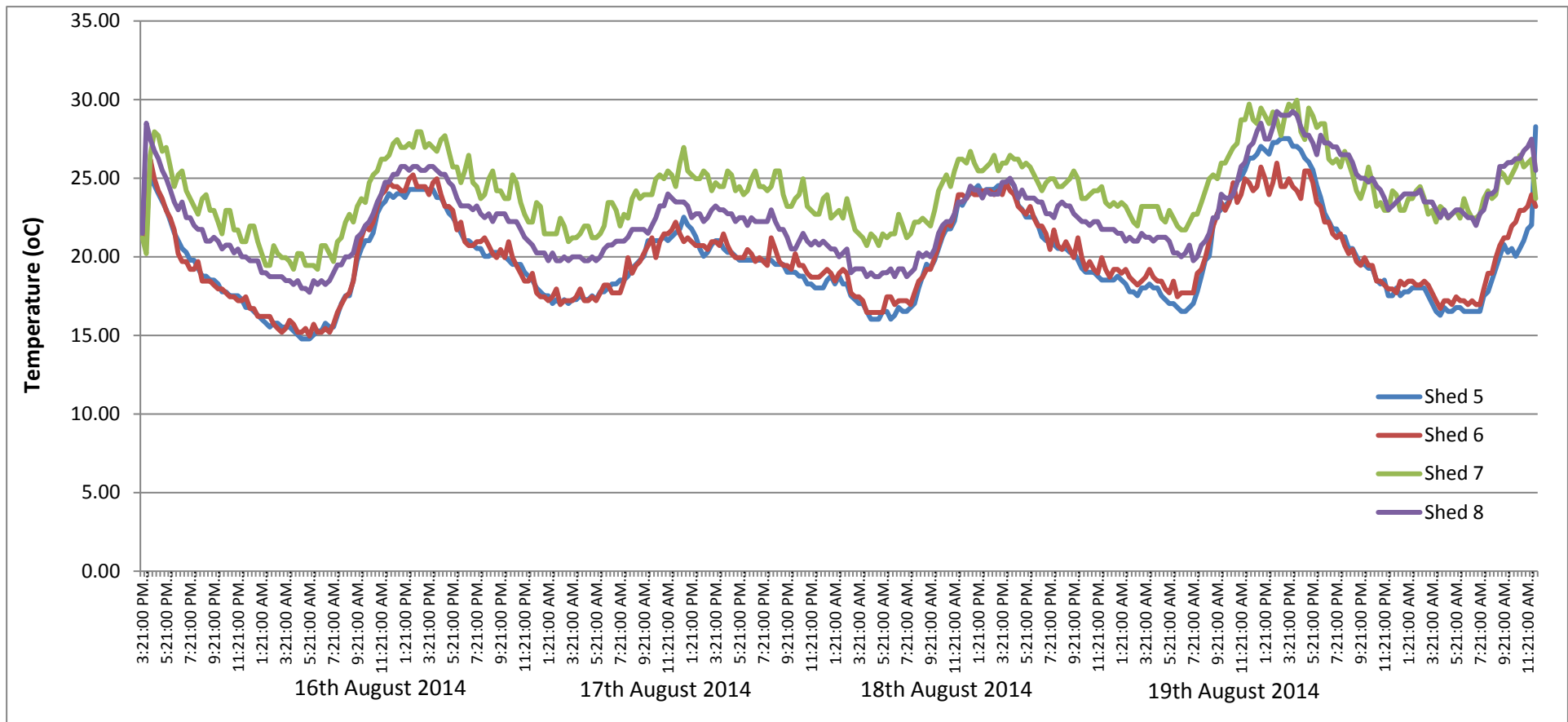


Figure 1. Temperature log in weaner sheds during the first week post weaning.



### *Grower/finisher fogging efficacy*

The output from the Scolexia fixed misting system was recorded on a daily basis. Average daily output for the entire shed was 2086 L/d, which based on the number of pigs at entry remaining constant equates to 0.58 L/pig/d. Water quality was an issue throughout the study, with the bag filter needing to be cleaned on a daily or even twice daily basis to ensure delivery.

### *Grower/finisher performance*

Post mortems were conducted on 98.5 % of all deaths and destructions during the grower/finisher period for determination of gross pathology as per Table 5. The only pigs that were not autopsied were a couple of deaths at the beginning of the grower period.

A total of 271 pigs died or were destroyed from 9 weeks of age through to sale. There were several spikes in APP associated mortalities as shown in Figure 2, with the control group having the first substantial break and the fogged as weaners group breaking two weeks later.

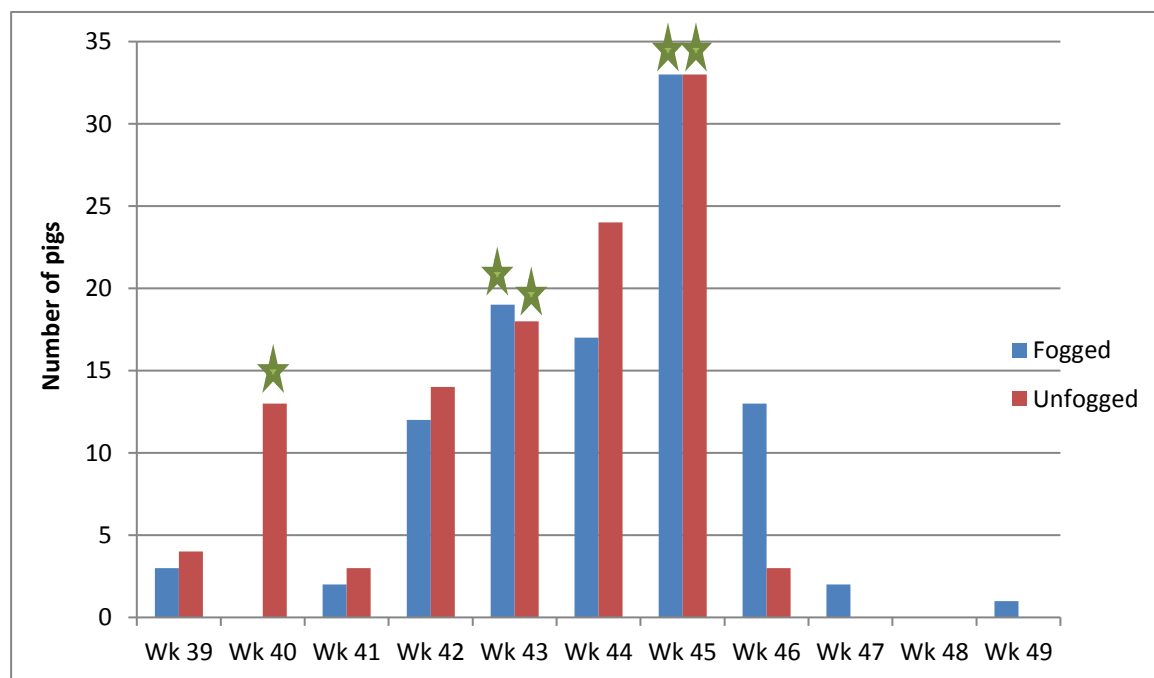


Figure 2. Number of pigs per week autopsied with pneumonia associated with APP (week 39 pigs not autopsied – number are sudden deaths assumed to be APP). Green stars represent intervention points of water medication in that half of the shed for APP control (amoxicillin week 40 and 43, CTC in week 45).

Table 5. Overview of post mortem results from the grower/finisher period

	Number post mortems	ENTERITIS	COLITIS	PNEUMONIA NOT APP	PNEUMONIA APP	MULTIPLE PATHOLOGY
Control	142	36	44	14	108	1.42

Fogged	125	33	33	10	99	1.40
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During the initial 5 week period (9 to 14 weeks of age) there was a trend for a greater number of deaths and destructions in the unfogged group compared to the animals fogged as weaners (unfogged – 3.2 %, fogged 2.2 %,  $P=0.061$ ,  $\chi^2=3.51$ ; Table 6). From 14 weeks of age through to sale the combined deaths and destructions were similar between the two groups (unfogged 4.9 %, fogged 5.2 %,  $P=0.65$ ,  $\chi^2= 0.21$ ). Over the entire test period there was no statistical difference in deaths and destructions between the two groups ( $P=0.48$ ,  $\chi^2= 0.51$ ).

Table 6 also displays the number of individual medical treatments administered from 9 weeks of age to sale to animals displaying respiratory distress. There was no statistical difference between the control or fogged groups in individual medical treatments (9-14 weeks age  $P=0.51$ ,  $\chi^2=0.43$ ; 14-21 weeks of age  $P=0.63$ ,  $\chi^2=0.23$ ).

Table 6. Overview of deaths, destructions and number of individual medical treatments for respiratory disease.

	9-14 weeks of age			14-21 weeks of age		
	Deaths	Destructions	Individual medications	Deaths	Destructions	Individual medications
Unfogged	41	16	33	70	14	154
Fogged	27	12	28	75	16	148

Coughing and sneezing scores were conducted on 5 pens per treatment group on a monthly basis (same pens each time) with the results displayed in Table 6. The results are presented on both an average per pen and an average per pig basis (due to mortalities the number of pigs per pen did differ as time progressed). On a per pig basis there were no main effects of fogging on cough score (control 0.037 coughs/pig in 3 mins; fogged 0.052 coughs/pig in 3 mins  $P=0.38$ ), nor were there any effects on sneeze score due to fogging (control 0.076 sneezes/pig in 3 mins; fogged 0.110 sneezes/pig in 3 mins  $P=0.15$ ).

Table 6. Monthly coughing and sneezing assessments during the grower/finisher period

	Days in shed				sed	Significance		
	Average coughs per pen	30	49	64		76	Fogging	Time
Control	4.08	1.28	0.28	0.08	0.58	0.37	0.003	0.003

Fogged	1.12	4.92	0.52	1.32				
Average coughs per pig								
Control	0.103	0.035	0.008	0.004	0.016	0.38	0.005	0.005
Fogged	0.028	0.130	0.013	0.036				
Average sneezes per pen								
Control	5.59	1.99	2.59	1.19	0.87	0.11	0.010	0.72
Fogged	6.21	2.41	5.41	3.01				
Average sneezes per pig								
Control	0.139	0.053	0.075	0.037	0.023	0.15	0.018	0.77
Fogged	0.154	0.063	0.143	0.079				

Table 7. Influence of fogging during the weaner period on performance from 9 weeks of age to slaughter

	Control	Fogged	sed	P-value
ADG	825.5	833.7	13.44	0.94
ADFI	1.68	1.67	0.029	0.73
FCR	2.01	2.00	0.023	0.61
HSCW	67.7	67.9	1.69	0.93
P2	11.0	11.3	0.42	0.60
Loin depth	50.6	50.1	0.65	0.56
Average lung score	2.43	2.31	0.205	0.57
Average pleurisy score	2.62	2.56	0.037	0.12

Slaughter checks were performed on all animals at the abattoir. The average lung and pleurisy scores on a pen basis are also displayed in table 8, while Figure 3 shows the influence of pen location within the shed on pleurisy and lung score. It appears that the pigs fogged as weaners and then housed furthest from the unfogged animals displayed lower pleurisy scores at slaughter, particularly the male side of the shed.

**Average Lung/ Pleurisy Scores**

Rep	Pen	Sex	Tmt	average lung score	average pleurisy score
1	1A	F	A	1.77	2.81
1	1B	F	A	3.62	2.78
1	2	F	A	1.24	2.81
1	3	F	A	1.81	2.83
1	4	F	A	2.29	2.49
1	5	F	A	1.68	2.58
1	6	F	A	1.93	2.59
1	7	F	A	2.43	2.53
1	8	F	A	1.78	2.35
1	9	M	A	3.58	2.51
1	10	M	A	1.81	2.58
3	11	M	A	1.11	2.64
3	12	M	A	2.57	2.68
3	13	F	A	2.30	2.18
3	14	F	A	1.90	2.57
3	15	M	A	2.03	2.54
3	16	F	A	1.63	2.68
3	17	F	A	2.06	2.56
3	18	F	A	1.11	2.69
3	19	F	A	1.86	2.61
3	20	F	A	2.48	2.58
3	21	F	A	1.45	2.59
3	22	F	A	2.52	2.21
	23	Sick Pen			

Rep	Pen	Sex	Tmt	average lung score	average pleurisy score
1	90B	M	A	2.72	2.68
1	90A	M	A	3.11	2.35
1	89	M	A	1.72	2.65
1	88	M	A	4.48	2.66
1	87	M	A	2.25	2.79
1	86	M	A	3.93	2.72
1	85	M	A	3.38	2.62
1	84	M	A	2.96	2.85
1	83	M	A	1.35	2.46
1	82	M	A	2.38	2.70
1	81	M	A	3.39	2.57
3	80	M	A	3.08	2.63
3	79	M	A	2.46	2.68
3	78	M	A	1.69	2.81
3	77	M	A	3.13	2.88
3	76	M	A	4.04	2.87
	75	M	A		
3	74	M	A	2.00	2.61
3	73	M	A	2.85	2.61
3	72	M	A	2.16	2.52
3	71	M	A	4.08	2.35
3	70	M	A	1.50	2.77
3	69	M	A	3.63	2.84
	68	Sick Pen			

2	24	F	B	2.17	2.88
2	25	F	B	2.30	2.53
2	26	F	B	2.84	2.61
2	27	F	B	0.53	2.72
2	28	F	B	2.19	2.93
2	29	F	B	1.64	2.70
2	30	F	B	1.70	2.56
	31	F	B		
2	32	F	B	4.48	2.69
2	33	F	B	3.61	2.50
2	34	M	B	4.57	2.58
2	35	M	B	4.00	2.22
4	36	M	B	2.81	2.46
4	37	M	B	1.65	2.46
4	38	F	B	2.04	2.56
4	39	F	B	1.40	2.89
4	40	F	B	1.89	2.49
4	41	F	B	0.55	2.70
4	42	F	B	1.93	2.61
4	43	F	B	1.29	2.24
4	44A	F	B	0.56	2.38
4	44B	F	B	1.14	2.44
4	45	F	B	1.63	2.27

2	67	F	B	2.78	2.80
2	66	M	B	2.42	2.77
2	65	M	B	3.20	2.75
2	64	M	B	2.50	2.62
2	63	M	B	2.21	2.59
2	62	M	B	2.36	2.69
2	61	M	B	3.72	2.70
	60	M	B		
2	59	M	B	2.55	2.55
2	58	M	B	2.55	2.62
2	57	M	B	1.54	2.64
2	56	M	B	2.29	2.66
4	55	M	B	1.33	2.24
4	54	M	B	0.94	2.63
4	53	M	B	1.17	2.50
4	52	M	B	2.58	2.56
4	51	M	B	3.50	2.50
4	50	M	B	4.54	2.66
4	49	M	B	3.84	2.39
4	48	M	B	3.28	2.17
4	47	M	B	1.64	2.59
4	46B	M	B	2.37	2.61
4	46A	M	B	1.48	2.19

## Discussion & Implications

The outcomes from this study show promise for mitigating the negative effects of APP in conventional progeny accommodation. Fogging during the weaner period resulted in a delay in the first APP outbreak after movement to the grower/finisher accommodation. The pigs fogged as weaners had one less water medication and a trend for fewer pigs dead or destroyed during the initial 5 weeks in the Big Dutchman facility. The fogged pigs housed furthest from the unfogged animals also appeared to display lower pleurisy scores at slaughter.

The Big Dutchman shed is very high risk for respiratory disease. Respiratory disease is proportional to the square of the population – 400 to 3200 pigs gives 64 times the risk of respiratory disease. In addition the shed has sheds on either side and end. The fogging system in the GF shed had shortcomings like running at low pressure – leading to larger droplets. The system has been reworked to be as close to ideal as possible. The next batch of pigs entered the facility week 3 2015. All pigs were fogged as weaners at Module 3 using the pedestal fans, and upon transfer to the Big Dutchman facility fogged using the fixed system. This batch of fully fogged weaners will determine if the following controlled factors are effective for APP, pleurisy and CRD control:

- All pigs fogged from weaning to sale
- Present vaccination programme (8/10/12/16 weeks age)
- 7 day age spread in group
- 800 PSI fogger – not as good as the 1000 PSI models