PCV2 Vaccination Strategy Experiment – Final Report 31st December 2009

Background:

The effects of PCV2 have devastated the pig industry in recent years. PCV2 infection increases mortality and feed costs and reduces growth rate and feed efficiency. Severe infection results in a significant reduction in net margin/pig (estimated at 2.3 to 16.0 euros/pig depending on the severity of infection: Pig International, March 2007).

Two different types of vaccine have recently become available to counteract this disease; one of which is given to the sow prior to farrowing and the other which is given directly to individual piglets at 3 weeks of age. These vaccines were compared at the Leeds University site of the Pig Development Centre, Spen Farm, between March 2008 and February 2009. At the start of the experiment post weaning mortality had been steady at around 12% for the previous two years. Three crossbred genotypes were used in order to make a comparison with previous work on the unit and also to gauge the impact of the vaccines on health and performance of each of these three genotypes.

Objectives:

1. To compare the health and performance of unvaccinated pigs to that of individually vaccinated pigs, to pigs from vaccinated mothers and to individually vaccinated pigs from vaccinated mothers in a 2 x 2 factorial experiment.
2. To investigate the effect of vaccination on the virology of PCV2

Methodology: Direct comparison of vaccinated and un-vaccinated pigs

This experiment determined:

1. The efficacy of vaccination against PCV2 in an affected herd which was recording 12% mortality post weaning prior to the start of any vaccination against PCV2.
2. The optimum vaccination protocol for controlling the ill effects of PCV2.

The experiment had a 2 x 2 factorial design:

Factor 1 Sow Vaccine – by batch, sows will be either vaccinated or unvaccinated with the Merial (Circovac) vaccine. Sows were equalised as far as possible across treatments for parity, size and litter history.

4 batches of sows will be vaccinated in two doses; 5-6 weeks prior to farrowing date and at 2-3 weeks prior to farrowing. After consultation with the pharmaceutical companies concerned the batches were run as follows:

Batch 11 - Unvaccinated
Batch 12 - Unvaccinated
Batch 13 - Vaccinated
Batch 14 - Vaccinated
Batch 15 - Vaccinated

Batch 16 - Unvaccinated
Batch 17 - Unvaccinated
Batch 18 – Vaccinated

Factor 2 Piglet Vaccine – within litter half the pigs were vaccinated with the Boehringer (Circoflex) vaccine, the remainder were left unvaccinated.

Each litter of piglets was weighed and sexed at 3 weeks of age and then all piglets allocated to either vaccinated or unvaccinated treatments, balanced as far as possible by weight and gender: Within any one litter pigs were allocated to vaccination treatment from heaviest to lightest. For the first litter a coin was flipped to determine whether the heaviest pig should be vaccinated or not, thereafter the operator worked through all litters of that batch vaccinating every alternate pig by weight. Tag number, weight and sex of each piglet were recorded at vaccination. All pigs were also vaccinated against pneumonia at this age.

All piglets were double tagged; one for individual identification and a second colour tag for group management. Vaccinated = red button tag, Unvaccinated = white button tag.

Hence 4 treatments were generated:

1. Unvaccinated control group
2. Vaccinated sow with unvaccinated piglets
3. Unvaccinated sow with vaccinated piglets
4. Vaccinated sow with vaccinated piglets

Sire Genotype

Batches 11 to 14, 17 and 18 comprised sows mated to Large White, Pietrain and Hampshire boars. Batches 15 and 16 were sired only by Large White boars.

Blood sampling

12 sows, 12 x 3 week pigs, 12 x 6 week pigs, 12 x 9 week pigs, 12 x 12 week pigs and 12 x 15 week pigs were blood sampled prior to the start of the experiment to establish a herd profile.

Vaccination efficacy comparison
Six sows per batch were blood sampled on transfer to the farrowing house.

48 pigs per treatment were blood sampled at 3, 9, 12, 15 and 18 weeks of age.

Results and Discussion

Initial viraemia

The initial viraemia on the farm prior to the start of any vaccination against PCV2 is shown in Figure 1 below. From this it is clear that pigs were becoming viraemic after 12 weeks of age. Consequently a final blood sampling point of 18 weeks of age was introduced for the post vaccination screening.

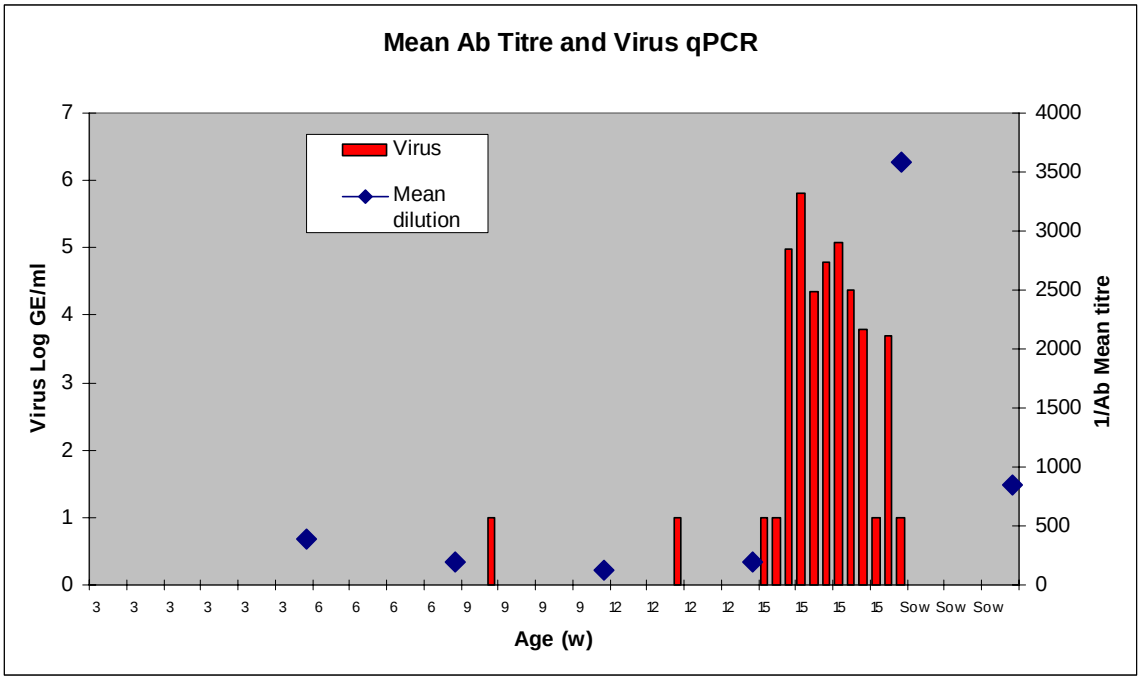

Figure 1. Initial viraemia of farm pigs prior to vaccination against PCV2

Impact of sow vaccination on subsequent pre-weaning performance – Litter effects (see Table 1)

Although every effort was made to balance sows equally across treatments, the experimental design meant that 11 more sows ended up on the non-vaccinated treatment.

There were no differences between sow treatments in terms of numbers of piglets born, live born, stillborn or mummies, nor in the weights of litters born.

Piglet mortality in the first 24h after birth was reduced in vaccinated sows; 4.2 % versus 7.4% for unvaccinated sows (P= 0.057) and this difference remained through to weaning although it ceased to be significant.

Vaccinated sows produced heavier litters at weaning at 4 weeks of age (P<0.05).

Table 1. Effect of sow vaccination against PCV2 on subsequent pre-weaning litter performance

Sow vaccination	**No**	**Yes**	*sem*	Probability
n=	97	86		
Parity	5.2	4.6	*0.26*	0.110
Total born	11.8	11.9	*0.44*	0.846
Born alive	11.1	11.1	*0.40*	0.997
Born dead	0.7	0.8	*0.13*	0.495
Mummies	0.21	0.25	*0.07*	0.722
Litter wt at birth (kg)	18.25	18.28	*0.66*	0.976
Live litter birthwt. (kg)	17.37	17.25	*0.63*	0.882
24h litter size*	10.6	10.4	*0.23*	0.560
24h litter wt (kg)*	16.8	16.7	*0.44*	0.887
Mortality to weaning	15.6	12.3	*3.00*	0.352
4 week litter wt (kg)	78.6	82.1	*1.24*	**0.044**

* after cross fostering

Impact of sow vaccination on subsequent pre-weaning performance – Piglet effects (see Table 2)

The data in Table 2 indicates that although there was no difference between sow vaccination treatments in the birthweight of live piglets, pigs from vaccinated sows rapidly showed improved growth rates compared to piglets from unvaccinated sows. They were significantly heavier by one week of age and the absolute difference between the treatments increased through to weaning.

Table 2. Effect of sow vaccination against PCV2 on subsequent pre-weaning litter performance

Sow vaccination	No	Yes	*sem*	Probability	Covariates
No. born	1183	1044			
No. Born alive	1112	971			
Birthweight (kg)	1.53	1.54	*0.022*	0.709	
Week 1 wt. (kg)	2.84	2.94	*0.031*	**0.005**	birthweight and week 1 age*
Week 3 wt. (kg)	6.07	6.32	*0.091*	**0.030**	birthweight and week 1 age*
ADG to 3woa (g/pig/d)	218	229	*4.5*	**0.047**	birthweight

*week 1 = 3 weeks prior to weaning and hence varies in length depending on the day on which the piglet was born

Impact of vaccination status on post-weaning performance (see Table 3)

Tables 3, 4 and 5 only refer to piglets of known genotype which were weaned. Table 3 indicates that within sow vaccination treatment piglets were successfully allocated to piglet vaccination treatment balancing for week 3 weight. Interestingly piglet vaccination tended to have a negative influence on growth rate between vaccination at week 3 and weaning one week later; this is likely due to the piglet diverting nutrients towards an immune response to the vaccine. Consequently during this period there was no response to the sow vaccination in terms of piglet growth rate.

From weaning onwards both vaccination types acted to improve pig growth rate without interaction between them. Interestingly when the data is broken down into periods it can be seen that the effect of the sow vaccine was most pronounced during the early growth of the pig, whereas, as would be expected, the impact of the piglet vaccine was more pronounced after 7 weeks of age. Hence both vaccines are effective in improving lifetime performance and shortening time to slaughter. Maximum effect was gained when the two were used together which resulted in 6 days advantage in slaughter age over the unvaccinated animal. Using either vaccine singly halved this advantage.

Table 3. Effect of vaccination against PCV2 on post weaning performance – comparison of vaccination of the sow only, the piglets only, both sow and piglets or neither sow nor piglets

Sow/piglet vaccination	**N/N**	**N/Y**	**Y/N**	**Y/Y**	*sem*	Probability sow vac	pig vac	interaction
n=	462	467	425	422				
Birthweight (kg)	1.59	1.59	1.65	1.64	*0.21*	**0.005**	0.743	0.928
Week 3 wt (kg)	6.26	6.25	6.49	6.49	*0.098*	**0.012**	0.958	0.929
Wean weight (kg)	8.1	8.1	8.5	8.4	*0.11*	**<0.001**	0.454	0.826
ADG weeks 3 to 4 (g/d)	266	256	278	261	*8.8*	0.232	**0.109**	0.646
Week 7 weight	13.9	14.0	14.6	14.8	*0.11*	**<0.001**	**0.066**	0.810
ADG weeks 4 to 7 (g/d)	286	293	321	332	*5.2*	**<0.001**	**0.083**	0.682
ADG w7 to slaughter* (g/d)	737	754	748	756	*4.3*	0.128	**0.003**	0.336
Post wean ADG (g/d)	669	683	688	698	*3.6*	**<0.001**	**0.001**	0.633
Lifetime ADG (g/d)	597	607	611	618	*28.6*	**<0.001**	**0.003**	0.588
Age at slaughter* (days)	166	163	162	160	*0.87*	**<0.001**	**0.009**	0.577

In Table 4 the data has been further broken down across sex and genotype, both of which have produced interesting significant differences. There were no significant interactions between main effects for time to slaughter. Female pigs unsurprisingly took longer to reach slaughter than male pigs. Hampshire crosses were fastest to slaughter, Large White crosses slowest and Pietrain crosses intermediate. Numerically the slowest pig type to reach slaughter was the piglet-vaccinated female Large White cross at 171 days of age, the fastest was the double vaccinated male Hampshire at 150 days of age – 3 weeks faster! The Large White showed the poorest response to vaccination with a total improvement of 5.7 days between unvaccinated female and double vaccinated male, a similar comparison in the Hampshire reduced time to slaughter by 12.4 days and in the Pietrain by 15 days.

Table 4
Effect of vaccination type, sex and genotype on the slaughter age of pigs killed at 99.9 kg liveweight

Sex	Female				Male			
Sow/piglet vaccination	N/N	N/Y	Y/N	Y/Y	N/N	N/Y	Y/N	Y/Y
Slaughter age d								
Hampshire	162.6	157.3	157.6	158.4	157.0	152.3	150.4	150.2
Large White	170.1	170.9	169.6	168.0	167.5	165.5	168.8	164.4
Pietrain	170.4	169.8	163.0	164.4	166.5	162.4	161.6	155.4

End weight covariate

sow vacc	P<0.001
pig vacc	P=0.009
Geno	P<0.001
sex	P<0.001

Impact of vaccination status on post weaning health and mortality

The impact of vaccination on post weaning mortality was disappointing with no significant effect of vaccination treatments (see Table 5). Overall farm post weaning mortality did half from around 12 % to 6.02 % during the trial (see Figure 2). However surprisingly this effect became apparent as soon as vaccination was introduced to the farm and there was no difference in post-weaning mortality across batches; it had been anticipated that mortality would decline across the unit during the experiment i.e. with successive batches as a greater proportion of pigs on the farm were vaccinated but this did not occur.

In terms of general health, fewer pigs tended to be recorded as ill if their mothers had received the sow vaccine (P<0.1). The piglet vaccine had no effect on the incidence of ill pigs in this experiment. PCV2 viraemia was observed after 15 weeks of age indicating that that the PCV2 challenge was occurring later in the herd than prior to the start of the experiment (see Figure 3). Interestingly piglets which had received the piglet vaccine had significantly lower PCV2 viraemia at 18 weeks of age than did either unvaccinated pigs or those which were from vaccinated mothers only. However this was not reflected in a noticeable improvement in health status.

Table 5. Effect of vaccination status on post weaning health

Sow/piglet vaccination	N/N	N/Y	Y/N	Y/Y	*sem*	Probability sow vac	pig vac	interaction
n=	462	467	425	422				
Postwean mortality (%)	7.1	4.8	5.9	5.6	*1.51*	0.918	0.385	0.499
Incidence of sick pigs (%)	17.2	18.4	12.6	15.2	*2.1*	**0.054**	0.353	0.715
Incidence of lameness (%)	2.5	2.7	2.6	2.1	*0.92*	0.787	0.894	0.732

Figure 2. Post weaning mortality on the experimental farm before and during vaccination against PCV2 (3 month rolling average)

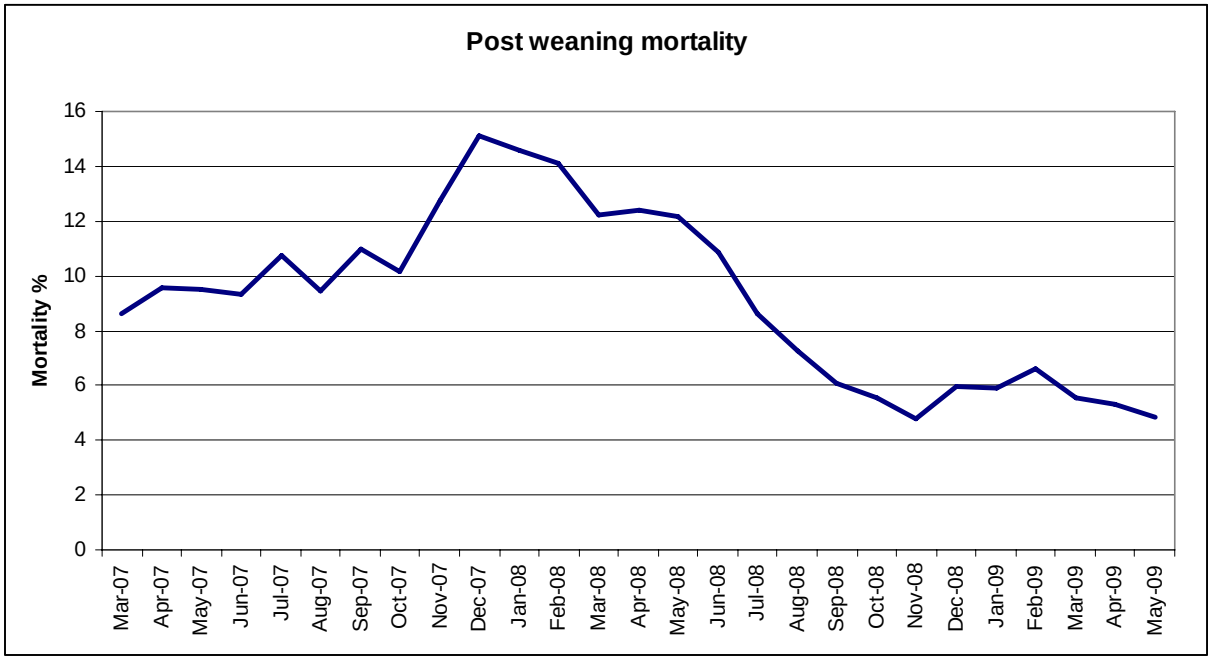

Figure 3. Percentage of pigs with a viral load of greater than 4 genome equivalents per ml resulting from each of the vaccination strategies