STUDY BULLETIN

PCV2 and Mycoplasma Vaccine Comparison in a Midwest Commercial Swine Herd

Merck Animal Health Swine Technical Services

Introduction

In this report, a swine veterinarian investigated the comparative benefit of a two-dose Myco Silencer® ONCE and Circumvent® PCV vaccination program vs. a one-dose Suvaxyn® PCV2 and RespiSure-ONE® program. The Midwestern farm had been using the one-dose PCV program for several years. The producer had noted repeated fluctuations in finishing performance, with occasional outbreaks of clinical porcine circovirus associated disease (PCVAD), as well as pneumonia due to *Mycoplasma hyopneumoniae* (Mhp). The farm also maintained an excellent record-keeping system enabling accurate data collection for comparative analysis of the two programs.

Materials and Methods

The study was conducted in a 700 sow farrow-to-feeder pig operation with separate off-site finishing. Routine diagnostic sampling confirmed that the farm was Porcine Reproductive and Respiratory Syndrome (PRRS) virus negative. The herd was positive for Mhp and PCV2, based on previous diagnostic testing and clinical signs. Pigs were weaned at 18 to 21 days of age, three days per week, and filled a nursery room of approximately 500 head over seven to 10 days. Each nursery room had its own feed bin. The finishing barns were comprised of two 500 head rooms each with separate feed bins. Pigs remained within distinct "all-in-all-out" groups in both the nursery and finishing phases. The pigs were weighed at weaning, at movement from the nursery to the finisher and at marketing. The Pig-CHAMP® record system was used to capture and analyze the production data. Feed disappearance and pig weight data collected by room group, enabled growth rate and feed conversion to be calculated for each group. Mortality and cull data were recorded for each group.

Three groups per treatment (two-dose vaccinates vs. one-dose vaccinates) were evaluated. The treatments were assigned in alternating fashion by room/group. A total of six groups were enrolled over a nine-week period. There were 1,579 pigs enrolled in the two-dose groups, and 1,623 pigs enrolled in the one-dose groups. The two-dose program was 2.0 mL of Circumvent PCV and 1.0 mL of Myco Silencer ONCE administered intramuscularly (IM) on the day of weaning and repeated 17 to 19 days later. These vaccinations were administered as two separate injections on opposite sides of the neck, except Group 5, which was administered as a mixture. The single-dose program was Suvaxyn PVC2 and RespiSure-ONE administered IM in separate injection sites on the day of weaning.

To evaluate post-vaccination serological responses, 15 randomly selected pigs from each group were double-ear-tagged at the time of the first vaccination and commingled with cohorts throughout the nursery and finishing phases. These pigs were bled on the day of weaning and again at approximately nine weeks of age. The sera were assayed with the PCV2 4-Dilution Indirect Fluorescent Antibody (IFA) assay, the PCV2 Differential ELISA, and the Mhp Tween 20 ELISA at the Iowa State Veterinary Diagnostic Laboratory (ISU VDL). A third and final bleeding of the tagged pigs occurred before slaughter, when the pigs ranged from 19 to 21 weeks of age. This sera was tested using the Mhp Tween 20 ELISA, the PCV 4-Dilution IFA, and the PCV2 qPCR assay using pools of three animals. If a pool was PCR positive, the individual samples were tested.

Full diagnostic work-ups were performed on dead or moribund pigs as determined by the farm manager and veterinarian. For statistical analysis, continuous variables (pig weights, growth rates and feed conversion rates) were evaluated by Analysis of Variance (ANOVA), with group as the experimental unit. Mortality and pig quality data were analyzed by Chi square with pig as the experimental unit. P-values ≤ 0.05 were considered significant.

Results

Diagnostic workups confirmed the presence of swine influenza virus (SIV/H1N2) in June 2010. There were no other confirmed outbreaks of disease during the study.

A complete summary of the production records by treatment is shown in Table 1, and an abbreviated summary of growth performance and mortality data presented in Table 2. Table 3 summarizes marketing data. In all three tables the average for each treatment, the absolute and percent difference between each treatment, and the corresponding P-value for each parameter are presented for the two production phases (nursery and finisher) and the combined wean-to-finish period.

Two-dose vaccinated pigs outperformed one-dose vaccinated pigs with regard to feed conversion ratio, mortality rate and the rate of substandard cull pigs. Treatment did not significantly impact growth rate. Weight at slaughter was greater for the two-dose vaccinated pigs although those pigs were in the finishing phase five days longer. Adjustment of the market weight using the average daily gain value for the finishing phase yielded no significant difference between the two treatments.

Serological response data is shown in Table 4. Pigs vaccinated twice with Circumvent PCV and Myco Silencer ONCE exhibited high titers to PCV2 as measured by both the 4-Dilution IFA and by the PCV2 Differential ELISA and exhibited high titers to Mhp as measured by the Tween 20 ELISA. The PCV2 Differential ELISA measures antibodies to antigens that are unique to Circumvent PCV and therefore can be used as a marker for vaccination response. Pigs vaccinated once with Suvaxyn PCV2 and RespiSure-ONE exhibited significantly lower serological responses post-vaccination.

At pre-market age, Mhp titer levels were significantly higher in the two-dose vaccinated pigs compared to the one-dose vaccinated pigs while the PCV2 IFA titers were higher in the one-dose vaccinated pigs. The titer increase observed in the one-dose vaccinated pigs between the end of the nursery and pre-market age confirms the presence of both Mhp and PCV2 field challenge to the pigs. PCV2 qPCR on the pre-market samplings found no viremia in the two-dose vaccinated pigs (14 pooled samples), while five of the 14 pools were positive for the one-dose vaccinated pigs ($P=0.057$).

Discussion

In most swine operations, the dynamics of PCV2 vaccination and disease coincide with the traditional division of the wean-to-finish phase into nursery, grower and finisher phases. The nursery phase is where vaccination occurs but disease is typically not present. Accordingly, the relative safety of vaccination can be evaluated during the nursery phase. In this study, there was no difference in any of the production parameters between the vaccine groups in the nursery phase. Accordingly, the second injection had no negative impact on nursery performance.

PCV2 disease typically is most severe during the traditional grower period or up to around 125 lb body weight. Thereafter, pigs can recover from the disease but there is little or no compensatory gain, so close-out performance is still impaired. In this operation, the grower and finisher phases were combined, which may tend to reduce the ability of the study to measure the full impact of PCV2 disease. Likewise, the sample size of three groups per treatment made it difficult to find significant differences in parameters that are group-based, such as rate of gain and feed conversion.

Despite these limitations, significant differences between treatments were identified in this study with regard to feed conversion, mortality, and pigs that were culled and/or judged to be substandard. For these three parameters, the two-dose pigs outperformed the one-dose vaccinated pigs. Although, rate of gain was not significantly different, the two-dose group out gained the one-dose group by 2.82%, which could result in as much as a 9.5 lb weight difference at harvest based on the approximate 168 day feeding period that occurred during the study.

Two-dose vaccinated pigs typically have significantly higher titers after vaccination than one-dose vaccinated pigs. Interestingly, the pre-vaccination titers for both PCV2 and Mhp tended to be higher in the two-dose vaccinated pigs. These maternally derived antibodies can potentially reduce serological responses after vaccination but in this study, the two-dose vaccinated pigs still exhibited a strong titer response to each antigen after vaccination.

The increase in titers observed in the one-dose vaccinated pigs provides strong evidence that both PCV2 and Mhp were active in this population of pigs. All one-dose vaccinated pigs exhibited a rise in titer between the post-vaccination and late finishing samples.

PCV2 titers obtained between the post-vaccination and late finishing periods were particularly noteworthy (Figure 1.). In two-dose Circumvent PCV vaccinated pigs, titers peaked post-vaccination and then declined through late finishing. Conversely, the titers from one-dose Suvaxyn vaccinated pigs increased progressively as pigs got older. This pattern has been repeatedly observed in other Circumvent PCV studies. Titers from Circumvent PCV vaccinated animals decline after the post-vaccination period even in the face of known PCV2 field exposure. It is believed that the Circumvent PCV immune response may neutralize the virus, reducing infection with subsequent serum titer reduction. Conversely, the Suvaxyn vaccinated pigs may not possess the same neutralizing capability or level of protection. In these one-dose vaccinated pigs, field exposure to PCV2 may stimulate a titer increase but fail to completely clear the virus. In this study, PCV2 was not detected by PCR in any of the two-dose vaccinated pigs whereas PCV2 viremia was only detected in Suvaxyn vaccinated pigs.

Figure 1. PCV2 serological comparison of two-dose vs. one-dose PCV2 vaccination.

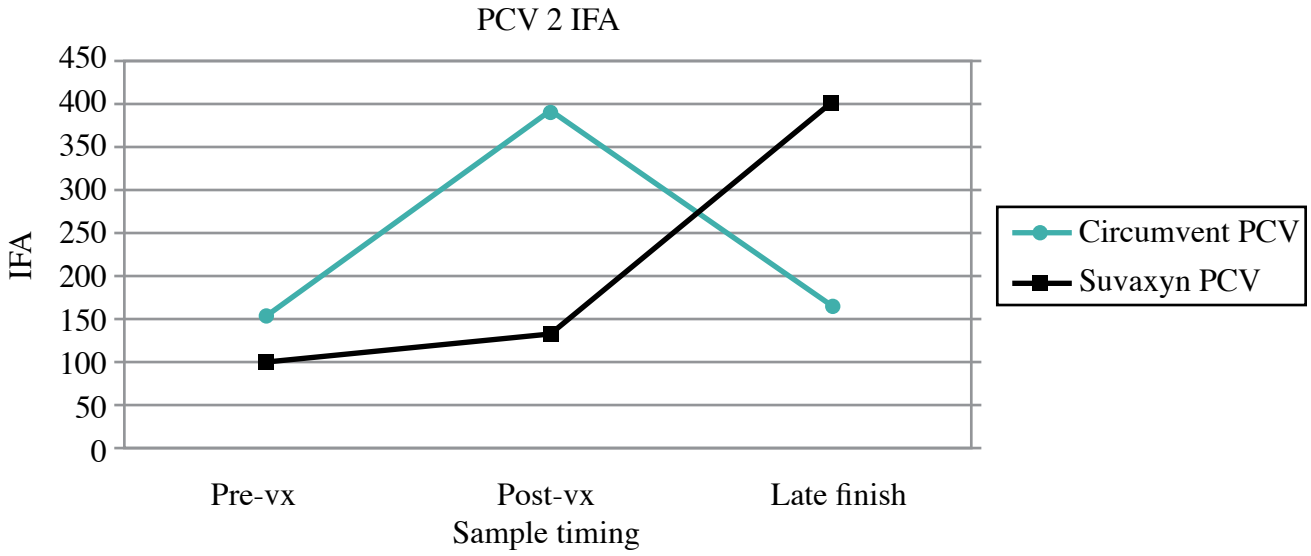

Table 5 provides an overall summary of the production and economic data. The assumptions for the economic model include:

1) 12 lb. wean weight

2) 290 lb. market weight

3) Mortality cost of $75 per dead pig

4) Value of substandard pig at 70% of full-value

5) 168 days on feed

6) $200 per ton feed cost

Using these economic parameters along with the production data generated from the study, the pig value favored the two-dose vaccinated pigs by $14.47 per pig over the one-dose vaccinated pigs. Table 6 provides a sensitivity analysis that demonstrates the difference in value per pig as prices change for each component of the economic model.

Because the study compared vaccination programs that involved two different vaccine antigens (PCV2 and Mhp), it is difficult to sort the relative benefit of one vaccine antigen from the other. Accordingly, in herds that are endemically infected with both PCV2 and Mhp (the majority of herds), the vaccine combination (i.e. the vaccination program) needs to be evaluated based on the overall benefit to the pigs and the producer when selecting the product(s) and dosing regimen.

Summary Points

Safety profile – Similar nursery performance between the two-dose and one-dose vaccinated pigs indicates a similar safety profile between the two vaccination programs.

Efficacy– Two-dose vaccinated pigs compared to one-dose vaccinated pigs had:

- 4.8 percent better feed efficiency
- 40.9 percent lower mortality rate
- 67.4 percent lower cull/substandard rate
- 2.9 percent faster growth rate (not significant)

Serology– Laboratory testing indicated significant titer responses could be monitored following two-dose vaccination for both Mhp ELISA and PCV2 IFA assays. PCV2 infection was better controlled in two-dose vaccinated pigs compared to one-dose vaccinated pigs based on viremia testing conducted in late-finishing.

Economics- The two-dose vaccination program showed a $14.47 per pig advantage versus the one-dose vaccination program.

Table 1: Complete Production Record Data Summary

Parameter	Test Group		Difference		P-value
	Two Dose	One Dose	Value	Percent	
No. of weekly groups	3	3	NA	NA	---
No. of pigs	1,579	1,623	-44	-2.7%	---
Start weight (lb.)	10.21	11.56	-1.35	-11.7%	0.1534
Nursery mortality	4.23%	3.94%	0.29%	7.36%	0.8829
Nursery average daily gain (lb.)	0.797	0.789	0.008	1.01%	0.9076
Nursery feed conversion ratio	1.292	1.288	0.004	0.31%	0.9643
Finisher mortality	3.37%	9.04%	-5.67%	-62.7%	<0.0001
Finisher ADG (lb.)	1.983	1.927	0.056	2.91%	0.4984
Finisher FCR	2.733	2.890	-0.158	-5.47%	0.0170
Wean-to-finish days	171.0	166.0	5.0	3.01%	0.3399
Percent pigs sold	92.5%	87.6%	4.91%	5.61%	<0.0001
Average weight of total pigs sold (lb.)	297.4	282.7	14.7	5.20%	0.0128
Average weight of total pigs sold adjusted (lb.)	293.3	286.7	6.6	2.30%	0.4960
Full value of pigs sold	91.1%	83.4%	7.77%	9.32%	<0.0001
Average weight full value pigs sold (lb.)	298.3	285.1	13.2	4.63%	0.0091
Substandard pigs sold	1.4%	4.3%	-2.9%	-67.4%	<0.0001
Average weight substandard pigs sold (lb.)	242.8	236.6	6.1	2.58%	0.3245
Wean-to-finish mortality	7.47%	12.63%	-5.16%	-40.9%	<0.0001
Wean-to-finish ADG (lb.)	1.680	1.633	0.047	2.88%	0.2038
Wean-to-finish FCR	2.560	2.688	-0.129	-4.80%	0.0039

Table 2: Abbreviated Performance Summary

		No. of pigs	ADG	FCR	Mortality
Nursery	Pfizer	1,623	0.789	1.288	3.94
	MERCK	1,579	0.797	1.292	4.23
	% Advantage	---	1.01	-0.31	-7.3
Finish	Pfizer	1,559	1.927	2.890[a]	9.04[a]
	MERCK	1,516	1.983	2.733[b]	3.37[b]
	% Advantage	---	2.9	5.5	62.7
Wean-Finish	Pfizer	1,623	1.633	2.688[a]	12.63[a]
	MERCK	1,579	1.680	2.560[b]	7.47[b]
	% Advantage	---	2.9	4.8	40.9

a,b Different superscripts indicate significant differences

Table 3: Marketing Data Summary

		% Total	Wt (lbs)	% Substandard	% Full Value
Marketed	Pfizer	87.6[a]	282.7[a]	4.3[a]	83.4[a]
	MERCK	92.5[b]	297.4[b]	1.4[b]	91.1[b]
	% Advantage	5.6	5.2	67.4	9.2

a,b Different superscripts indicate significant differences

Table 4: Serology Data Summary

	Mhp ELISA				PCV2 4-Dilution IFA				PCV2 Differential ELISA	
	Two Dose		One Dose		Two Dose		One Dose		Two Dose	One Dose
Sample Time	Avg. Titer	No. Positive	Avg. Titer	No. Positive	GM Titer	No. Positive	GM Titer	No. Positive	No. Positive	No. Positive
Pre-Vacc.	0.067[a]	2/45[a]	0.113[b]	8/45[a]	157.6[a]	23/45[a]	100.8[b]	11/45[b]	NA	NA
Post-Vacc.	1.134[a]	46/47[a]	0.173[b]	14/44[b]	389.2[a]	39/46[a]	134.5[b]	13/44[b]	47/47[a]	0/44[b]
Late Finishing	0.914[a]	43/43[a]	0.545[b]	34/41[b]	167.9[a]	29/43[a]	398.7[b]	33/41[a]	NA	NA

a,b Different superscripts indicate significant differences

Table 5: Overall summary and economic data

Parameter	All Pigs		Percent Improved	Value Per Pig
	One Dose	Two Dose		
Mortality (%)	12.6	7.5	40.9%	$3.83
ADG (lb.)	1.63	1.68	2.9%	NA
Feed: gain	2.69	2.56	4.8%	$3.61
Substandard (%)	4.3	1.4	67.4%	$1.57
Market weight (lb.)	281.6	290.0	3.0%	$5.46
Economic advantage				**$14.47**

Table 6: Sensitivity analysis for prices

Parameter	Base Level	Incremental Change		Economic Change Per Pig
		Value	Percent	
Cost per Dead Pig	$75	$5	6.7%	$0.26
Feed cost per ton	200	$20	10.0%	$0.36
Substandard pig value	70%	5%	7.1%	$0.11
Market price (cwt)	$65	$5	7.7%	$0.42

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