Funding the search for better knowledge into porcine circovirus PCV2

Grants amounting to €650,000 have been awarded to European projects since 2007 under an annual programme to encourage applied research into the circovirus PCV2 and the disease pictures linked to it.

by Dr Bernd Grosse Liesner, Global Technical Manager for Swine Vaccines, Boehringer Ingelheim Animal Health. boehringer-ingelheim.com

Decisions on pig health care have changed significantly in Europe over the past decade, regarding the use of vaccination in controlling the diseases associated with the virus known as PCV2. It is an extraordinary story of success that continues to expand as applied research and practical experience give even better insights into the virus itself and the diseases associated with it.

First steps

Porcine circovirus type 2 (PCV2) was found initially in 1998 inside lesions of young pigs suffering from the post-weaning multisystemic wasting syndrome or PMWS, a disease picture characterised by weight loss and respiratory distress in affected piglets. Happily, this discovery linking the virus to PMWS was followed by one of the first successes, when the launch of piglet vaccines for PCV2 made clear that active immunisation protected pigs very well against the systemic disease.

The next chapter of the story saw evidence accumulate over time that PCV2 is also involved in other forms of disease with enteric or respiratory symptoms. In addition, and perhaps even more significantly given the number of animals potentially at risk, it has become evident that a subclinical infection with the virus can have a negative impact on the performance of unprotected piglets.

These events have had an important consequence. Today, vaccinating piglets against PCV2 has become a standard measure for the control of the virus in practically all swine industries globally.

In Europe the current estimate is that about 85% of piglets are vaccinated as a regional average, although in some individual European countries the proportion is already in the range of 90-100%. Meanwhile there has been a re-shaping of European attitudes about vaccination targets. As well as applying the vaccine directly to piglets, herds in Europe now also give it to sows and gilts in order to extend the protection of herds.

The winners of the 2016 PCV2 research award with members of the Review board and representatives of Boehringer Ingelheim.

Award scheme promotes research

Over the same period of the last 10-15 years, fortunately, pig health research has brought considerable progress in understanding the disease processes that involve PCV2 and how to protect pigs against the virus. A large part of the extra knowledge gained in Europe in the intervening years can be attributed to independent research studies carried out at institutes and universities and by veterinary clinics.

Motivated by a desire to support such investigations, Boehringer Ingelheim Animal Health decided almost 10 years ago to create and fund an annual European PCV2 Research Award. The first submissions for it were received in 2007.

The intention behind this award programme is to encourage independent applied research involving innovative methods to probe porcine circovirus type 2 in terms of immunity, pathogenesis and epidemiology as well as the possible interaction of the virus with other pathogens or microbes.

Judging of the proposals received is also always independent. They go to a review board composed of European scientists who are acknowledged leaders in applied porcine research. Those judges decide the winners of up to three prizes annually, each worth €25,000 towards the cost of the

Continued on page 21

Table 1. New terms for PCVDs, diseases associated with porcine circovirus type 2.

Classification	Coverage	Main signs	Former terminology
PCV2-SD	Systemic disease in piglets	Wasting, pale skin, diarrhoea, jaundice	PMWS
PCV2-LD	Lung disease	Respiratory distress	Proliferative and necrotising pneumonia
PCV2-ED	Enteric disease	Diarrhoea	PCV2-associated enteritis
PCV2-RD	Reproductive disease	Stillborn, mummified piglets, returns to oestrus	PCV2-associated reproductive disease
PCV2-SI	Subclinical infection	Reduce growth rate	(no previous term)
PDNS	Effects on skin and kidneys	Dark red skin patches on hind legs, swollen kidneys	(unchanged)

Continued from page 19
study. With the ninth edition of the award which was granted earlier this year, a total of 26 projects in Europe have been chosen to receive funding in the past nine years. The combined value of the grants to them amounts to €650,000.

Footprints of progress

The projects recognised by the PCV2 Award over the past decade help both to chart how the development of knowledge surrounding the virus has progressed and to identify the focal points of ongoing research. During the early years of the award programme, for example, the researchers wanted to improve their explanation of disease processes such as by a project to define a challenge model for PMWS in pigs and through studies of the role of the virus in enteric and reproductive disorders. Work of this type has produced a clearer understanding of the different disease pictures that is also reflected in a new approach to their nomenclature.

A quick guide to the new terminology now being widely adopted by veterinarians is set out in Table 1.

It begins by grouping together the various conditions linked to the virus under the collective title of porcine circovirus type 2 diseases or PCVDs.

Within this category is the use of PCV2 systemic disease (abbreviated to PCV2-SD) to replace the term PMWS and a reference to PCV2 lung disease (or PCV2-LD) instead of the former name PNP. A similar style is used for enteric and reproductive diseases. But the porcine dermatitis and nephropathy syndrome PDNS retains its original name at present because its links to PCV2 remain to be proven scientifically.

Worth noting, too, is that PCV2 subclinical infections are listed under the PCVDs, even though by definition the affected pigs do not show clinical symptoms. This accommodates the fact that, despite the absence of clinical signs, the presence of these subclinical infections can have a huge impact on the pigs' ability to perform well.

Investigating vaccines

Other studies to receive an award have looked at how PCV2 vaccines work under differing conditions. For example, it was shown that Ingelvac CircoFLEX is protective against different sub-types of the circovirus – a vital consideration in practice, given the genetic variability of this virus which is now generally regarded as existing in four genotypes although the one classified as PCV2b is by far the most prevalent worldwide.

The protection provided by the vaccine against multiple sub-types has been demonstrated consistently by testing with numerous isolates and this is in line with the vaccine's consistent efficacy seen in the field.

Another aspect of vaccine efficacy was examined by a study in Spain supported by the research award. This work took 600 piglets at two weeks old that had been born to either vaccinated or non-vaccinated sows. Half of the piglets were then given the same vaccine at three weeks of age and followed through to 25 weeks.

Weighing of the pigs and blood testing at intervals revealed that the Ingelvac CircoFLEX piglet vaccination was highly efficacious and improved pig performance compared to non-vaccinated pigs, even in the presence of high levels of maternal antibodies.

The focus of separate studies has been on what the vaccine actually does in the pig. A key finding from a Spanish project was that vaccinating with Ingelvac CircoFLEX induces an orchestrated tripartite immune response – at innate, humoral and cellular levels – which leads ultimately to the excellent effectiveness of the vaccine. That agrees with the conclusion reached by a study in France to compare vaccinated and non-vaccinated pigs for the rate at which they transmitted the virus. These researchers concluded that vaccination significantly reduced transmission, suggesting that infection would spread more slowly in a vaccinated herd and might with time even fade away.

The obvious question this raises is whether vaccination might be used ultimately to eradicate PCV2 from a farm. It was explored by a research project awarded in 2011, in which investigators in Spain tried mass-vaccinating both sows and piglets with Ingelvac CircoFLEX at a farm for one year. During this process the pressure of infection due to the virus was reduced to undetectable levels. But exposure to PCV2 was detected again when vaccination stopped – demonstrating that the virus had not been eradicated.

Studies on sows

More recent PCV2 award projects have probed the influence of the virus on sow herd performance and the extent to which these effects can be controlled by vaccination. Although not all of these investigations have been completed yet, preliminary results from them show that sow vaccination does indeed protect the sows from the negative impact of a PCV2 infection during gestation.

Two projects funded through the 2015 edition of the award are investigating the role of virus transmission from sow to piglet within the overall spread of the pathogen. The first of these studies wants to answer whether the infectious status of the sow changes over the course of the reproductive cycle and what implications this brings for her ability to pass virus to her offspring.

The main point under investigation in the second project is the frequency with which piglets are infected by PCV2 before birth.

As a company we are excited by all these possibilities and we remain determined to support the battle to beat PCV2 in pig herds globally. In fact, we have decided already that the European PCV2 Research Award programme will continue and are looking forward to receiving proposals for the European PCV2 Research Award 2016! ■

Landmarks in the history of PCV2 control

1993-95: Piglet disease PMWS described

1998: PCV2 characterised as present in PMWS lesions

2000: Testing starts of conventional inactivated vaccines on sows and weaned pigs with aim of beating PMWS

2004: First licensing in Europe of an inactivated vaccine for use on sows and gilts to stimulate antibodies that can be passed to piglets through colostrum

2005-06: Wider implications of a PCV2 infection become recognised

2007: Subunit vaccine launched in Europe for vaccination and protection of piglets

2007-08: PCV2 linked to reproductive failure in gilts; in sows, effects of virus on embryo/foetus survival are shown to depend on the stage of gestation at which infection occurs

2008-09: Direct vaccinating of piglets now generally regarded as the most effective way of protecting them through to slaughter weight

2009: Piglet vaccination identifies the existence of subclinical infection as daily growth rate improves even in pigs that show no overt clinical signs

2009-10: Revaccination of gilts at selection or before their placement in the herd becomes widely used

2010-11: Vaccinating the sow is seen increasingly as helpful against sub clinical infection in sows

2014-15: Vaccinating sows before mating is shown to improve farrowing rates by helping to maintain pregnancies past the first trimester, a benefit seen across all parities

2015: CV2 vaccines are now the most widely purchased of all pig health protection products worldwide