

Porcine Reproductive and Respiratory Syndrome control in Asia

Porcine Reproductive and Respiratory Syndrome (PRRS) continues to be one of the most economically devastating viral diseases affecting pig farms in major swine producing countries in Asia. Recent data from Japan showed a reduction of 53.7g per day on ADG and an increase of 2.2% in post-weaning mortalities in PRRS positive farms as compared to the production performance of PRRS negative farms.

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However, although many farms are infected, the clinical impact of PRRS infection varies. Different factors lead to such variability in the clinical presentation including the strain infecting the herd, the type of production (single site farrow-to-finish vs multi-site systems), the season (weather), the presence of co-infections prior to PRRS introduction, the pig density in the immediate locality of the farm and the way the farm manages their replacement breeders.

Effective control programs focus on addressing the predisposing factors through management changes and on ensuring herd immunity is well established. Different approaches have been done to stabilise herd immunity to PRRS including exposing the sow herd to infected animals or live virus and doing whole herd vaccination.

However, although vaccination is increasingly used in Asia to reduce the impact of PRRS, the results have been variable. Many factors may have contributed to the differences in efficacy of vaccines, but the major difference is PRRS vaccine strain used in the final formulation and its ability to provide effective cross protection against the predominant field PRRS strains.

Genetic sequencing has been used extensively in identifying PRRS virus strains, however, it is of limited use in predicting the phenotype of the virus – its immunogenicity and virulence. Although PRRS viruses in the same lineage may share

similar genetic characteristics, it is very difficult to expect potential cross neutralisation or cross protection based on genotyping alone, so PRRS vaccines need to be proven to provide cross protection in controlled challenge of immunity studies using representative isolates from different lineages.

Fostera PRRS (modified live virus based on P129 strain, Type 2 Genotype) has been launched in different markets in Asia since 2014. Zoetis have looked into the ability of this product to provide effective cross protection against representative strains in different challenge of immunity studies done in Korea, Vietnam and Thailand. Summaries of each study are discussed below.

Cross Protection Study against Genotype 1 PRRS

The European PRRSV (SNUVR090485 strain) used as a challenge virus in this study was isolated from a 1000-sow herd in southwestern Kyounggi Province, Korea. The homology of nucleotide sequences between SNUVR090485 strain and Fostera PRRS vaccine strain is 61.1% based on ORF 5 sequence and 62.3% based on ORF 7 sequence.

In this experiment, a total of 148 colostrum-fed, cross-bred, conventional piglets were purchased at 14 days of age from a commercial PRRSV free farm. All piglets were negative for PRRSV, porcine circovirus type 2 (PCV2) and swine influenza virus based on serological tests. All piglets were negative for type 1 and type 2 PRRSV viraemia by real-time polymerase chain reaction (PCR). Fostera PRRS was given to piglets in the vaccinated and challenged group, while placebo was given to piglets in the non-vaccinated and challenged group at 21 days of age. At eight weeks of age, both groups were challenged intranasally with 3ml of tissue culture fluid containing 10⁶ tissue culture infective doses 50% (TCID₅₀)/mL of SNUVR090485.

Necropsy was conducted on a subset of pigs from each experimental group at 7, 10, 14 and 21 days post challenge. The mean rectal temperature, mean respiratory scores, level of viraemia, macroscopic and

microscopic lung lesion scores and mean number of PRRSV-positive cells per unit area of lung detected by IHC were significantly lower in the vaccinated and challenged group as compared to the non-vaccinated and challenged group.

Cross Protection Study against Genotype 2 Lineage 1 PRRS

The North American PRRSV (SNUVR090851 strain) used as a challenge virus was isolated in lung samples from newly weaned pigs in a 1000-sow herd in Chungcheung Province, Korea in 2010. The homology of nucleotide sequences between SNUVR090851 strain and Fostera PRRS vaccine strain is 87.2% on ORF 5 and 92.7% on ORF 7.

Fostera PRRS was given to piglets in the vaccinated and challenged group, while placebo was given to piglets in the non-vaccinated and challenged group at 21 days of age. At eight weeks of age, both groups were challenged intranasally with 3ml of tissue culture fluid containing 10⁶ tissue culture infective doses 50% (TCID₅₀)/ml of SNUVR090851.

Necropsy was conducted on a subset of pigs from each of the experimental groups at 7, 10, 14 and 21 days post challenge.

The mean rectal temperature, mean respiratory scores, level of viraemia and nasal shedding, macroscopic and microscopic lung lesion scores and mean number of PRRSV-positive cells per unit area of lung detected by IHC were significantly lower in the vaccinated and challenged group as compared to the non-vaccinated and challenged group.

Cross Protection Study against Genotype 2 Lineage 8 PRRS

The Vietnamese HP-PRRSV (strain MB6, Genbank number KM244760 and KM244761) used as the challenge virus in this experiment was isolated from a 30-sow herd in northern region of Vietnam in 2009.

The Vietnamese HP-PRSV and vaccine virus (Fostera PRRS classified in lineage 8, Zoetis) share 91.7% (93.2%) and 95.0% (91.7%) amino acids homology (nucleotides

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homology) for open reading frame (ORF) 5 and ORF7, respectively.

A total of 48 colostrum-fed, cross-bred, conventional piglets were purchased at 14 days of age from a commercial PRRSV free farm. All piglets were negative for PRRSV, porcine circovirus type 2 (PCV2) and swine influenza virus based on serological tests.

All piglets were negative for type 1 and type 2 PRRSV viraemia by real-time polymerase chain reaction (PCR) at the time of selection. Foster PRRS was given to piglets in the vaccinated and challenged group, while placebo was given to piglets in the non-vaccinated and challenged group at 21 days of age. At eight weeks of age,

both groups were challenged intranasally with 3mL of tissue culture fluid containing $10^{5.5}$ tissue culture infective doses 50% (TCID₅₀)/mL of Vietnamese HP-PRRSV (strain MB6, 4th passage in MARC-145 cells). Necropsy was conducted on three pigs per experimental group at 7, 10 and 14 days post challenge.

The mean rectal temperature, mean respiratory scores, level of viraemia and nasal shedding, macroscopic and microscopic lung lesion scores and mean number of PRRSV-positive cells per unit area of lung detected by IHC were significantly lower in the vaccinated and challenged group as compared to the non-vaccinated and challenged group.

Cross Protection Study against Genotype 2 Lineage 8 PRRS

HP-PRRSV (10PL1) that was used in this experiment was isolated in Thailand in 2011. A total of 39 piglets (from PRRSV-free herd, negative results for anti-PRRSV antibody using ELISA (IDEXX HerdChek PRRS ELISA) and negative results for PRRSV RNA using RT-PCR) were randomly allocated to the three treatment groups (T01 – non-vaccinated and non-challenged, n=9; T02 – non-vaccinated and challenged, n=15; and T03 – vaccinated and challenged, n=15). Pigs in the vaccinated group (T03) were immunised with Foster PRRS at four weeks of age.

All challenged groups were inoculated intranasally with 5mL of tissue culture fluid containing 10^4 tissue culture infective doses 50% (TCID₅₀)/mL of Thai HP-PRRSV (10PL1 strain) four weeks post vaccination.

The survival rate of the vaccinated and challenged group was significantly higher at 80% as compared to the 20% survival rate of the non-vaccinated and challenged group. Also, the mean serum virus titers of the vaccinated and challenged group were significantly lower than the non-vaccinated and challenged group at three and seven days post challenge.

Pigs in the vaccinated group also had gained weight (average weight gain is 3.97kg) during the challenge phase of the study (day 28-42), while the surviving non-vaccinated pigs lost an average weight of 2.47kg per head.

Effective cross protection

Due to the differences in the study design, cross-study comparison is not recommended. However, in most of the studies presented above, the consistent observations in comparing in-study experimental groups is that Foster PRRS vaccinated groups had reduced fever, reduced respiratory scores, reduced mortalities, reduced challenge virus viraemia and nasal shedding as compared to non-vaccinated controls, indicating an effective cross protection against heterologous challenge.

These results were attributed to the ability of Foster PRRS to induce good cell mediated immunity that is cross protective against the challenge isolates used, leading to less viraemia, less lung lesions and less clinical impact of the challenge.

From these controlled challenge immunity studies conducted in different Asian countries, it can be concluded that Foster PRRS vaccination can induce effective cross protection against heterologous PRRS challenge from different genotypes and lineages used in these experiments. ■



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