PRRS – Back to the FUTURE

Ricardo Neto
Pig disease breakthrough promises to bring home the bacon for Genus

Genus is claiming a breakthrough in the breeding of pigs that renders them resistant to a serious disease.

Shares in the livestock genetics company rose by 31p, more than 2 per cent, to close at £14.96 after it announced the development of the first pigs that are resistant to the porcine reproductive and respiratory syndrome virus, via a collaboration with the University of Missouri. The Basingstoke-based Genus hailed the research as “a significant breakthrough in combating this devastating porcine disease”, which causes animal reproductive failure, reduced growth and premature death.

Jonathan Lightner, the company’s chief scientific officer and research chief, said: “The demonstration of genetic resistance to the PRRS virus by gene-editing is a potential game-changer for the pork industry.” He acknowledged that there were still “several critical challenges ahead”.

MSD Animal Health
ANY QUESTIONS?

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Porcine Reproductive and Respiratory Syndrome (PRRS)

- History
- Epidemiology
- Clinical picture
- Diagnostics
- Conclusions
Porcine Reproductive and Respiratory Syndrome (PRRS)

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History

• Since 1986 known in the U.S.
• Since 1987 known in Canada
• Since autumn 1990 severe outbreaks in Germany
• Since begin 1991 outbreaks in The Netherlands, Belgium, U.K., Spain and France
• In 1991 isolation of Lelystad virus as causal agent
• Serological evidence of presence in most pig producing countries, e.g. The Philippines, Japan, Poland, Italy

(e.g. Proceedings IPVS 1994)
Introduction of the virus in Europe around 1990: agent not known at that time

- Life born piglets / litter: 10.7 to 10.3
- % mortality farrowing units: 13.7 to 16.4
- Weaned piglets / sow / year: 20 to 18
### Relation PRRS status 51 batches fatteners and ADG

<table>
<thead>
<tr>
<th>sero.status</th>
<th>&lt;794*</th>
<th>&gt;794</th>
</tr>
</thead>
<tbody>
<tr>
<td>negative 15%</td>
<td>37%</td>
<td>63%</td>
</tr>
<tr>
<td>positive 85%</td>
<td>68%</td>
<td>32%</td>
</tr>
</tbody>
</table>

*ADG average Nederland 2011

### Table 2: Relationships: odds ratio between serology and performance results

<table>
<thead>
<tr>
<th>serology</th>
<th>techn. / slaughter results</th>
<th>O.R.*</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRRS +</td>
<td>high pleurisies</td>
<td>8.0</td>
<td>(= 0.0029)</td>
</tr>
<tr>
<td></td>
<td>high pleurisies + pneumonia</td>
<td>6.2</td>
<td>(= 0.0028)</td>
</tr>
</tbody>
</table>

* Significant associations (P<0.05) P-value based on Fisher’s exact test
The virus

- RNA virus
- Enveloped

Two genotypes have been reported:
  - Type I = European (Lelystad as prototype)
  - Type II = American (VR2332 as prototype)

- High genetic variation amongst field viruses within genotype have been reported worldwide
Porcine Reproductive and Respiratory Syndrome (PRRS)

- History
- Epidemiology
- Clinical picture
- Diagnostics
- Conclusions
Epidemiology

- Incubation period
- Transmission
- Survival
- Sources
Porcine Reproductive and Respiratory Syndrome (PRRS)

- History
- Epidemiology
- Clinical picture
- Diagnostics
- Conclusions
Clinical: Acute phase
- Sows
- Piglets
- Fattening pigs

Clinical: Endemic phase
- Sows
- Fattening pigs

Subclinical infection
Cost benefit of PRRS control

► PRRS virus normally affects sows in the latter stages of pregnancy, hence whole litters are lost.

► Assume the cost of production and loss of margin is £33.2/pig, a litter loss is 11 pigs x £33.2/pig = £365.2/litter

► If vaccine costs £1.5/dose and sows farrow 2.3 times/year, then the cost/sow vaccinated is £3.45/sow/year

► The loss of one litter’s production equates to the cost of Porcilis PRRS vaccinating more than 100 sows/year!

► Grower/finisher vaccination

- 2 kg extra at slaughter
- Not considering medication costs

Putt M.. (2014)
Porcine Reproductive and Respiratory Syndrome (PRRS)

• History
• Epidemiology
• Clinical picture
• Diagnostics
• Conclusions
• Immuno fluorescence test (IFT)
• Immuno peroxidase monolayer assay (IPMA)
• ELISA
• SN
• PCR
• VIRUS ISOLATION
Diagnostics

► ELISA

- Measured antibodies DON’T protect against PRRS.
- Antibodies indicate a PRRS contact (field virus and/or vaccination).
- Antibody levels give NO indication for:
  - clinical impact of PRRS infections
- Clinical history and vaccination history is very important for a correct interpretation.
- Exposure to PRRS virus in grower – finisher herds

- Antibodies to PRRSV following infection
- Antibodies from sow colostrum

- % positive
  - Weaning
  - 5 to 7
  - 8 to 10
  - 11 to 13
  - 15+

- Weeks of age
Diagnostics

 ► ELISA
   – Timing of seroconversion (the 14 days!)
   – Herd status
   – Timing of vaccination!? 

Figure 1. PRRS ELISA seroprofile
Diagnostics

► PCR
- Detects antigens (the virus itself)
- Available to test sera, tissues and oral fluids
- Can detect positive animals from one day post infection (dependant on challenge dose)
- Generally not detectable 4 – 6 weeks post infection (some breeds longer)
Diagnostics

Diagnosis for sows

► Weak born piglets, early farrowing, sometimes abortions.

► Demonstrating PRRS virus in piglets:
  – PCR or PRRSv isolation

► Increase of antibodies in sows:
  – Paired sampling
  – Problem sows - healthy sows
Diagnostics

Diagnosis for feeding herd

- Respiratory problems, secondary bacterial infections (increase Glasser’s, Strep, etc)

- Demonstrating PRRS virus:
  - PCR or PRRSv isolation

- Increase of antibodies in:
  - Paired sampling
  - Cross sampling
PRRS Control Program with vaccination

► For any successful PRRS control program, excellent Biosecurity is needed. If not present, this should be corrected before / simultaneously when implementing a vaccination program.

► Create a decision tree that takes in consideration various aspects of PRRS control and make the right decision for each situation.
  – This is an interactive tool
Decision Tree Components

► Biosecurity
► Herd Status
► Vaccination strategy
► ROI of strategy
Implementation of PRRS control strategy

Step 1:

- Diagnosing PRRS situation
  • Is Breeding herd stable?

- Pending risk assessment and economics initiate:
  1. Strategic vaccination in piglets
  2. Mass vaccination (whole herd program)
     1. Scheme’s: - “60-6” : mid gestation and Farrowing unit.
     2. Herd vaccination (3-4 /y): Constant infection pressure towards sows

     1. How many times?
     2. Followed by “maintenance” vaccination program?
Implementation of PRRS control strategy

► Step 2:

  Vaccination
  - Sow vaccination is helpful in achieving stable sow herd
  - Gilt vaccination: prevention of viral introduction and infection.
  - Optional: Piglet vaccination:
    In case of clinical problems
    Constant circulation of the virus despite biosecurity measurements

  Biosecurity

► Step 3: (each 3 – 6 months)
  - Monitoring: Diagnostic: cross sectional (see step 1)
    Clinical, technical, economical
Implementation of PRRS control strategy

New armory?

Yes

IDAL gun prevents horizontal spread

HP-PRRS challenge in pigs vaccinated with Porcilis PRRS

- Kelly Lager et al., National Animal Disease Center, Ames, IA, USA

- Objective
  - To evaluate efficacy of Porcilis PRRS in pigs vaccinated at 4 weeks of age and challenged with HP-PRRSv (rJXwn06, 65% homology) at 8 weeks of age.
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**Implementation of PRRS control strategy**

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Implementation of PRRS control strategy

New armory?

- Viremia

![Graph showing viremia levels over days post-challenge]
Implementation of PRRS control strategy

New armory?

Yes

IDAL gun prevents horizontal spread

• Preliminary results demonstrate that pigs vaccinated with Porcilis PRRS had:
  • higher weight gains
  • reduced viremia
  • less mortality

than challenge controls following a severe experimental challenge with HP-PRRS.
Implementation of PRRS control strategy

- Modified Live Vaccine (Porcilis® PRRS) prevents reproductive symptoms and transmission of the virus in the piglets (uterus) (can’t cure already infected piglets in the uterus)

- Scheme’s:
  - “60-6” : mid gestation and Farrowing unit.
  - Herd vaccination (3-4 /y): Constant infection pressure towards sows

Troubles with separation of sows
Acute outbreaks (IDAL)

PRRS control and eradication
PRRS control and eradication on farms is possible with MLV vaccines with Ro < 1.

Reduction of:

proportion of infected animals

length of viraemia

shedding
Reproduction Ratio ($R_0$)
  - The number of animals that one infected animal will further infect
  - If greater than 1
    • Spread throughout a population will occur
  - If less than 1
    • An infection will inevitably die out
Reproduction Ratio >1
Reproduction Ratio >1
Reproduction Ratio >1
Reproduction Ratio >1
Reproduction Ratio >1
Reproduction Ratio >1
Reproduction Ratio >1
Reproduction Ratio <1
Reproduction Ratio <1
Reproduction Ratio <1
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PRRS control and eradication on farms is possible with MLV vaccines with Ro < 1

Porcilis PRRS

0.01 v Woensel
0.06 P. Astrup
0.02 N Rose
0.53 G. Pileri

Reduction of Porcine Reproductive and Respiratory Syndrome virus (PRRSv) transmission in vaccinated pigs

Pileri, E., Gibert, E., Soldevila, F., Garcia-Saenz, A., Pujols, J., Diaz, I., Darwich, L., Casal, J., Martin, M., Mateu, E., Vaccination with a genotype 1 modified live vaccine against porcine reproductive and respiratory syndrome virus significantly reduces viremia, viral shedding and transmission of the virus in a quasi-natural experimental model, Veterinary Microbiology (2014), http://dx.doi.org/10.1016/j.vetmic.2014.11.007
ERADICATION

- Destock / partial destock
- Vaccination (Mass vaccination, depends on management system)
- Wash clean disinfection
- Herd closure
- Gilt (replacement vaccination)
- Biosecurity (visitors etc)

- Need to strictly follow protocol
- Risk of reinfection
  - Region level
New armory?

Yes

IDAL gun prevents horizontal spread
Better understanding of farm dynamics
New tools?

duration of immunity
transplacental infection
cross protection
Implementation of PRRS control strategy

New armory?
Yes
IDAL gun prevents horizontal spread
Better understanding of farm dynamics
New tools?

duration of immunity
Porcilis 24 weeks Vs 17 weeks
Onset of immunity
Porcilis 28 days Vs 5 weeks
Implementation of PRRS control strategy

New armory?

Yes

IDAL gun prevents horizontal spread

Better understanding of farm dynamics

New tools?

transplacental infection

• Porcilis - “A significant improvement of the reproductive performance in PRRS virus contaminated environments and a reduction of transplacental virus transmission after challenge was observed in vaccinated pigs”

Vs

• “reduction in transplacental virus transmission after challenge” and “In piglets born to vaccinated sows, a reduction in the negative impact of PRRSV infection (mortality, clinical signs and weight gain) was also demonstrated during the first 20 days of life.”
New armory?

Yes

IDAL gun prevents horizontal spread

Better understanding of farm dynamics

New tools?

transplacental infection

- Porcilis - “A significant improvement of the reproductive performance in PRRS virus contaminated environments and a reduction of transplacental virus transmission after challenge was observed in vaccinated pigs”

Vs

- “piglet was tested viraemic at weaning.”
Porcilis PRRS is effective against heterologous EU PRRSv challenges as demonstrated in trials with challenge isolates ranging between 78% to 94% in homology.
Implementation of PRRS control strategy

New armory?

Yes

IDAL gun prevents horizontal spread

Better understanding of farm dynamics

New tools?

duration of immunity
transplacental infection
cross protection

Different European-type vaccines against porcine reproductive and respiratory syndrome virus have different immunological properties and confer different protection to pigs

-Heterologous vaccine provided better protection than homologous based on absence of viremia
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► One of the most costly diseases to the pig industry
► Great impact on health, profitability and welfare
► Serology tool allows monitoring of farm conditions
► Flexibility of vaccination programs and control of disease outbreaks
  – Porcilis PRRS can be used as:
    • mass vaccination vaccine
    • Routine vaccination regime in stable herds
► One lost litter = vaccinating 100 sows
ANY QUESTIONS?

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