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Eradication of PRRS virus by changing the pig flow and the introduction of negative replacements into positive sow farms

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Introduction

Porcine reproductive and respiratory syndrome virus (PRRSV) has become one of the most costly and widely distributed swine diseases in the world (1).

Due to the economic losses associated with this disease, strategies to control PRRS infection and its effects have been a priority for the swine industry. Several strategies have been described and proven to work in certain conditions. Success depends on identifying the source of virus for the farm, where the virus recirculates, how the gilt pool is managed, and whether there are available negative sources for replacements and semen. However, generally effective control measures have proven to be elusive.

More recently there have been several reports in which control of PRRSV infection has been taken a step further. In these reports the idea of PRRSV eradication, not just control, has been explored. Some of the reports were based on test and removal (2), mass vaccination and unidirectional pig flow (3), farm closure and roll over with negative replacements (4), sow farm stabilization and weaning of negative pigs to establish negative farms (4).

The objective of this paper is to provide evidence for eradication of PRRSV in swine farms by changing the pig flow and by introducing negative replacements in positive herds.

Principles to support eradication by changing the pig flow and the introduction of negative replacements in positive herds

Evidence to support this strategy are based on field observations that suggest that, in closed populations, the viral infection dies out over time (5, 6). The principles supporting PRRSV eradication by this method were recently summarized elsewhere (4). Briefly, those principles can be summarized as follows:

- *Immunity*: Pigs previously infected with, and recovered from, PRRSV are immune to experimental, homologous challenge for extended periods of time, suggesting that homologous immunity is protective (7). In addition, preliminary data may suggest the lack of infectious virus in animals that have developed a strong—although delayed—cellular immune response (8). Importantly, this immunity may take up to six months to fully develop (8).
- *Biosecurity/transmission*: During the process of a PRRSV elimination, there will exist populations of pigs with differing immune status (immune vs. susceptible) at the same time on the farm. During this time, it is essential to identify all possible sources of virus and establish optimal biosecurity measures between the different immune populations and accommodate pig flow to prevent transmission. Biosecurity measures to prevent the introduction of new viral strains also need to be strengthened.
- *Assessment and definition of the population*: The dynamics of the viral infection within the farm must be defined. It is important to identify where the virus recirculates, at what age the pigs become infected, the nature of the replacements, and whether animal flow can be adequately managed to allow segregation, if needed.
- *Replacement animal introduction*: A consistent source of negative replacements and semen is needed.
- *Sentinels as biologic indicators of infection*: Using sentinel animals as biologic indicators to ascertain that there is no virus recirculation on the farm and to build confidence on the timing to safely begin introduction of negative replacements is effective.
- *Attrition effects on sow population*: Previously exposed infected animals will need to be removed. Whether removal of previously infected pigs is done by test and removal, accelerated culling based on age, or by normal attrition, the fact is that previously exposed animals are a risk factor for transmitting infection to susceptible animals. At this time, even though elimination by normal attrition is attractive, data is lacking to recommend this method over others. However, clinical experiences to date indicate that this method may be a safe, effective, less costly method to achieve successful PRRS elimination.

PRRSV eradication protocol

This strategy is based on the introduction of negative replacements in seropositive farms at a time when no signs of virus re-circulation are observed in the breeding herd. Introduction of the negative animals will be followed by attrition or scheduled culling of the previously infected animals. This strategy will develop a negative population of breeding animals over time.

- The candidate sow farm must stand alone and not be exposed to growing animals other than nursing pigs. The herd should be closed to new introductions for a period of time. Our rule of thumb is to have at least six months between the last introduction of positive gilts and the introduction of the negative replacements.
- In our opinion, the final additions of replacement animals, likely the last gilts/boars that have been actively infected, are considered the highest risk animals for virus transmission. Therefore, measures to keep them segregated the longest should be emphasized.
- Only negative replacements should be considered as a source for replacements. These replacements should be introduced after assessing the lack of infectious virus in the sow farm by the use of sentinels. Negative replacements can be introduced directly into the breeding/gestation area and incorporated to the normal farm flow or directly into farrowing, if an off-site breeding project is utilized. This option allows production to maintain breeding targets, minimize production losses, and maximize the time during which the farm will have no replacement introductions.
- While possible during the process, the integrity of each farrowing room—either as a group of sero-positive sows or as negative replacement/sentinel gilts—should be maintained. Piglets derived from sero-positive sows and negative gilts will be mixed at weaning. No cross-fostering should be allowed between both distinct serologic populations. Piglets from the last positive and first negative gilts should not overlap at farrowing or weaning, minimizing the risk for transmission from the animals estimated as most recently infected. Breeding needs to be planned accordingly. This gap in gilt litters is also used to manage nursery depopulation more effectively in the case that multi-site or off-site production is not available.
- Off-site nursery and finisher facilities are desired. If a nursery depopulation is considered, this should be done after farrowing all positive gilts and only when lateral transmission can be prevented. A monthly monitoring protocol based on ELISA can verify that growing pigs remain negative through the nursery and finisher stages.

Farms suitable to adapt this protocol will include those that are positive and endemic to PRRSV infection. These farms should also have been consistently acclimatizing gilts prior to introduction in the sow farm so that all animals present at the farm have been previously exposed and immune to virus infection.

End point measures of success

This goal is met through ongoing clinical observation of the herd, diagnostic testing, and removal of infected animals.

- Clinical signs characteristic of PRRSV infection are not observed over time.
- Negative status must be achieved for the herd as a whole. Any direct or indirect evidence of virus presence must be negative.
- Ongoing negative status must be affirmed with adequate, periodic testing; careful clinical assessment of herd health; and assurance of negative replacement animal status.
- Known negative sources for semen and replacement animals must be utilized and continuously monitored to confirm absence of infection
- All animals known to have been infected at any point in their life have been removed from the herd, regardless of their specific, individual serologic status.

If fulfillment of the definition of a PRRS-negative farm implies the removal of all previously exposed animals, it is evident that PRRSV eradication will be a long-term goal that will be achieved in the best cases within 1-2 years after the initiation of the project. In practice, more confidence is gained over time by having the negative replacements stay negative and the pig flow also stay negative. Therefore, during the course of the eradication project, there will be populations of pigs that will be negative; the following populations can be distinguished:

- Positive sow farm with a consistent negative pig flow in the nursery and finisher stages. This is risky, as any given group can go positive.
- Positive sow farm with negative replacements remaining negative after being introduced in the sow farm and having negative pig flow.

In order to monitor the serologic status of the pigs, the following monitoring is recommended (conducted monthly and based on statistical sampling):

- Negative replacements in isolation and the source for negative semen

- Negative gilts after introduction into the positive herd (>30 days)
- Nursery pigs older than seven weeks of age (avoiding interference with maternal antibodies)
- Finishing pigs

Results

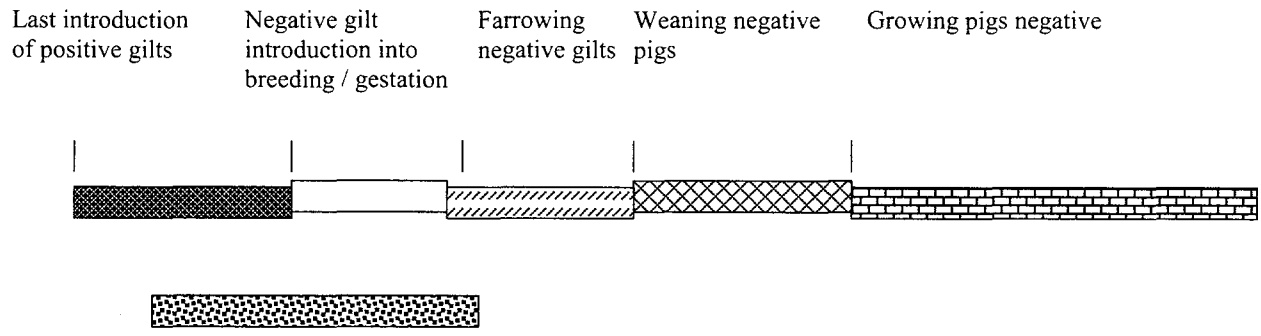
At present, there are 13 farms undergoing a PRRSV elimination plan that follow the procedure described above. (Note that most of these PRRSV elimination projects are still under progress and at different stages of the PRRS elimination process.)

Figure 1 shows the stage of the PRRS elimination projects for each of the farms.

- There are two farms that have been consistently producing negative pigs for more than six months (farms U and R). Negative replacements for these two farms, after being mixed with the positive sows, have remained negative to date.
- Another farm has been producing negative pigs for the past two years and negative replacements have remained negative since then (farm Pl). In this farm only a handful of previously exposed old parity sows are left. These sows will be culled at weaning, and if the negative status is maintained, the farm will be considered negative.
- Farms P, C, and B have started farrowing the negative replacements. Negative replacements remained negative through gestation, although they were mixed with positives at breeding (farms had been previously closed for 4-6 months). It still remains to be determined whether pig flow will remain negative through nursery and finisher stages. A nursery depopulation to prevent lateral transmission is under completion in farm P.
- Farms S and H have introduced negative replacements directly into the breeding/gestation area after a previous closure of the farm (time ranges from 2-6 months). Negative replacement status is monitored monthly. In some of these farms, negative replacements are kept segregated in a different barn away from the last positive gilt. In farm H, negative replacements are incorporated into the farm's normal pig flow.
- Farms HR and M had the opportunity to conduct an off-site breeding project with the negative replacements. Negative replacements will be introduced into the sow farm at farrowing.

In most of these cases, a sentinel program had been established previous to the introduction of the negative replacements. Negative results on the sentinels where used to either plan breedings for the negative replacements or to build confidence on the timing when the negative replacements where to be mixed with the positives.

Figure 1: Stage of PRRSV elimination by farm



Negative introduction into breeding / gestation: Farms S and H

Farrowing negative gilts: Farms P, C and B

Growing pigs negative: Farms U, R and PL

Off-site breeding project with negative gilts: HR and M

Three farms initiated a PRRS elimination project but failed to either maintain negative replacements, the sow farm was clinical with PRRSV clinical signs, or the pig flow did not remain negative (farms A, HW, T respectively).

- Farm A was a small farrow-to-finish farm without isolation that, even though this farm had been considered stable at the time of the initiation of the PRRS elimination project, the negative replacements where housed too close to the positive pig flow.
- Farm HW experienced a mild PRRS outbreak right before the negative pregnant replacements where introduced into the sow farm. A genetically distinct, previously non-diagnosed PRRSV isolate was identified on this farm. Whether this virus had been at the farm previous to the appearance of the abortions or was a laterally introduced virus could not be confirmed.
- Farm T also experienced clinical PRRSV during the time the farms were closed and after negative replacements were introduced. The source of the virus for these abortions could not be identified.

In summary, from the 13 PRRS elimination cases presented here, there have been three cases in which PRRSV elimination had to be temporarily abandoned. Whether PRRSV eradication programs are considered a failure for these cases is debatable, since in two of the cases negative replacements had not yet been incorporated into the farm's pig flow. In these cases, a threat in biosecurity or the appearance of previously unidentified PRRSV strains should be considered as the potential reasons for the failure of the programs.

For the remaining ten farms that follow the proposed PRRS elimination projects, a monthly status evaluation will be conducted. The most critical time periods are when negative replacements are mixed with positive sows and when piglets from positives and negatives are commingled at weaning. Since most of the current PRRS elimination projects are (at the time of writing) at those stages, very valuable information will be generated in the following months. (Updated information will be presented orally at the Leman Conference.)

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References

1. Benfield DA, Collins JE, Dee SA, Halbur PG, Joo HS, Lager KM, Mengeling WL, Murtaugh MP, Rossow KD, Stevenson GW, Zimmerman JJ (1999). Porcine Reproductive and Respiratory Syndrome. In: *Diseases of Swine*, Iowa State University Press, pp: 201-232.
2. Dee SA (1998). Elimination of PRRS virus using a test and removal process in conjunction with serology and PCR diagnostics. *Proc Am Assoc Swine Pract*, Des Moines, IA, pp 117-118.
3. Dee SA, Philips R (1998). Using vaccination and unidirectional pig flow to control PRRSV transmission. *Swine Health and Prod* 6(1): 21-25.
4. Torremorell M, Henry S, Moore C (2000). Producing PRRSv negative herds and systems from PRRSv positive animals: the Principles, the Process and the Achievement. *Proc Am Assoc Swine Pract*, Indianapolis, IN, pp 341-347.
5. Harris DL, Bevier GW, Wiseman BS (1987). Eradication of transmissible gastroenteritis virus without depopulation. *Proc Am Assoc Swine Pract*, Des Moines, Iowa, p 555.
6. Freese WR, Joo HS (1994). Cessation of porcine reproductive and respiratory syndrome (PRRS) virus spread in a commercial swine herd. *Swine Health and Prod* 2(1): 13-15.
7. Lager KM, Mengeling WL, Brockmeier SL (1997). Duration of homologous porcine reproductive and respiratory syndrome virus immunity in pregnant swine. *Vet Microbiol* 58:127-133.
8. Meier WA, Wheeler J, Husmann RJ, Osorio FA, Zuckermann FA (2000). Characteristics of the immune response of pigs to wild-type PRRS virus or to commercially available vaccines: an unconventional response. *Proc Am Assoc Swine Pract*, Indianapolis, IN, pp 415-418.