Techniques for PRRSV elimination utilizing modified live virus vaccine on single-site swine farms

Thomas G. Gillespie¹, DVM, Diplomate ABVP; Amy L. Carroll²
¹ Rensselaer Swine Services, Rensselaer, Indiana; ² Purdue University, West Lafayette, Indiana

Porcine Reproductive and Respiratory Syndrome (PRRS) has played a large role in the North American swine industry over the past several years. This disease can be very devastating to a herd, leading some herds to undergo PRRS virus (PRRSV) elimination projects. This paper is designed to present some options and general guidelines for PRRSV elimination programs incorporating modified live vaccine on single site farms. However, there is not a single protocol for elimination that will work on every farm. The elimination protocol must be designed for each farm individually based on their pig flow and facility design as well as serological results.

Many different techniques have been described for PRRSV elimination projects, with varying results. Some of these techniques include used herd closure¹, mass vaccination with modified-live virus (MLV) vaccine²³, temporary off-site weaning³, partial depopulation⁴, test and remove programs⁵, deliberate exposure to field virus¹, and even spontaneous elimination in a few scattered cases. A variety of techniques that have been employed successfully on large farms will be discussed here. It must be remembered that the first goal is to control field virus and the second goal is then to eliminate all virus, both field and vaccine strains, from the farm.

Modified live virus vaccine

Many advantages are realized from incorporating MLV vaccine into an elimination program. MLV vaccine provides a more uniform virus exposure than field virus, therefore requiring a shorter time period for adequate immunity in all animals. The usage of a killed virus (KV) vaccine product has not been shown to induce as great of a level of protection as MLV vaccines against highly virulent PRRSV strains⁶⁷. In addition, MLV vaccines are less costly than KV vaccines, reducing the cost of PRRSV control and elimination.

MLV vaccine can be used to stabilize a herd to PRRSV by either mass vaccination or a routine booster vaccination protocol. In the author’s experience, an animal does not shed vaccine virus after being exposed to at least two doses of vaccine, therefore providing protection from field virus without concern about shedding of vaccine virus. This concept is of great importance in an elimination program. After the sow herd has been vaccinated with at least two doses of MLV vaccine and become stable, naïve animals can be introduced into the breeding herd without removing the positive animals. There is little concern of virus shedding from the vaccinated animals to neighboring naïve animals. This allows for PRRSV elimination without total depopulation of the breeding herd and minimizes the length of time for herd closure.

Mass vaccinations with MLV vaccine is a favorable option to ensure that all animals are properly vaccinated and develop immunity simultaneously. If a herd has been routinely vaccinating replacement animals two times prior to entry into the herd and giving a booster dose to breeding animals, one mass vaccination may be sufficient. Depending on herd size and population dynamics, many of these herds still require mass vaccination even though most animals have been exposed to vaccine at least two times. Recurrent open females and other such animals may be missed with booster doses of vaccine and, therefore subpopulations are created which do not have adequate protection and may shed PRRSV when exposed. Mass vaccination of all breeding animals will ensure that these subpopulations do not create problems when naïve animals are introduced. If two mass vaccinations are required to provide adequate exposure to all animals, they should be scheduled at a thirty day interval to achieve maximum protection levels.

MLV vaccine can be used for virus elimination in pig populations after the breeding herd has been stabilized.
Strategic vaccine usage will be determined based on serological profiles. Ideally, vaccine placement should be four weeks prior to virus exposure since it takes this long for the development of neutralizing antibodies and an effective immune response. Vaccination of a population of pigs will provide protection from field virus and eliminate any virus circulation within the facility.

**Herd stabilization**

PRRSV elimination can be thought of as a two-step process. The first step is to stabilize the sow herd. Mass vaccination with modified live vaccine is a viable option for sow herd stabilization. A stable herd can be defined as a herd in which there is lack of clinical signs or virus transmission between animals. Stable herds will produce naïve pigs from vaccinated sows and will have no virus transmission to naïve incoming replacement animals. Both horizontal and vertical transmission issues must be assessed. This can be accomplished by polymerase chain reaction (PCR) testing of nursing piglets to detect vertical or horizontal spread from the sow to piglets. Enzyme-linked immunosorbent assay (ELISA) testing of sentinel animals in the gestation barn is also utilized to detect sow-to-sow horizontal spread. The second step of a PRRSV elimination project to stop seroconversion in the pigs, which may rely on a combination of vaccine usage, pig flow and biosecurity.

**Serology**

Elimination projects must begin with serological profiling of different subunits of the herd not only to determine any virus activity in the breeding herd, but also to determine when seroconversion is occurring in the pigs. Both PCR and ELISA testing are powerful tools to be strategically utilized in an elimination program. PCR testing is useful to determine exposure in young pigs due to virus shedding from the sow. Pigs will be viremic within 24 hours post-inoculation and would therefore have a positive PCR test much earlier than could be detected by ELISA testing. A positive ELISA titer will not be detected until at least 10 days post-inoculation. When performing PCR testing on suckling piglets, 7–18 day old piglets should be chosen to maximize the possibility of horizontal virus transmission if it is taking place. The selected piglets should also be of litters from the youngest females. It is possible that gilts and young sows may not have been exposed to as many doses of vaccine and would therefore be at the most risk of shedding vaccine virus or lack protection from field virus.

If PCR testing in young pigs establishes that naïve pigs are being produced, then ELISA testing can be utilized to determine when virus exposure and seroconversion is occurring. This information can be used to structure the protocol for elimination. Vaccine placement in pigs relies on the timing of exposure. Vaccine usage may be implemented as early as three to four days of age if seroconversion is occurring in the nursery phase or it can be as late as early finisher if seroconversion is not occurring until the mid-to-late finisher phase. In addition to vaccine timing, other management techniques, such as nursery depopulation and herd closure are structured around serological profiling.

There must be protocols in place for monthly herd monitoring of various production stages in order to ensure stabilization and to determine the efficacy of the elimination program. Such a routine monitoring program provides early detection of PRRSV exposure, allowing for immediate intervention strategies to be implemented if needed. Serological monitoring must involve random sampling of the herd, representing all production stages. Sample size needs to be statistically determined in order to detect a significant infection. A protocol designed to detect a 5% infection prevalence with a 95% confidence level is often employed in the early stages of an elimination program. The protocol can be changed to detect a 10% prevalence with a 95% confidence level in the later stages of an elimination program after PRRSV has been eliminated.

In addition to utilizing serological testing to assess herd stabilization and timing of seroconversion, PRRSV strain differentiation can also be an integral part of developing an elimination protocol. For example, strains with a predicted RFLP pattern of 1–4–2, or other “atypical” PRRSV strains, have traditionally been more difficult to control and may require some special considerations for elimination. This may include extended periods of vaccine usage, prolonged herd closure or other more extensive management techniques. Strain differentiation is also useful in PRRSV monitoring programs to determine if positive ELISA titers are the result of exposure to vaccine or field virus. Virus sequencing can also be utilized in this role, as it is far more sensitive and specific than strain differentiation, but is also more costly.

**Sentinel animals**

Naïve sentinel animals play an integral role in any elimination program. These animals can be introduced...
into the breeding herd after the herd has been stabilized via mass vaccination. The use of sentinel animals is a sensitive tool for detection of horizontal spread of PRRSV within the breeding herd. Sentinels should be randomly dispersed throughout the barn to be able to maximize detection of any localized virus shedding. Successful use of sentinels depends on the number of animals used and the frequency of testing. Monthly serological monitoring of sentinels adds confidence of finding low incidence rates.

Nursery depopulation
Depopulation of nursery pigs is an option in a PRRSV elimination program to create a disruption of pig flow between exposed pigs and naïve pigs. After the sow herd has become stabilized and naïve pigs are being produced, nursery depopulation may be required to prevent virus transmission. In herds experiencing seroconversion in the nursery and therefore vaccinating suckling piglets, there must be a break between these pigs and the younger naïve pigs. However, if pigs are not seroconverting until the mid-finisher stage or later, a nursery depopulation and break in pig flow may be avoided since all pigs are already naïve in the nursery. This is a major advantage since any disruption of pig flow adversely affects the cash flow and profitability of a farm.

Herd closure
Herd closure has been implemented in many PRRSV elimination protocols with much success. This is not always necessary in all situations. Herd closure allows time for the virus to settle down in the breeding herd after vaccination or field virus exposure so that it will not be shed to incoming naïve animals. When using MLV vaccine, shedding has not been observed after two doses, producing a stabilized herd in a rather short time period. After a herd is stabilized, naïve animals can be introduced and serve as sentinels. If incoming replacement animals are vaccinated two times prior to entry into the herd, they should be stable to PRRSV. Therefore, naïve animals can be introduced immediately following vaccinated animals without a disruption in the schedule of gilt introductions.

Facility design and biosecurity
Traditionally, elimination of PRRSV has been more difficult on single site farms. During most elimination programs, the sow herd is stabilized first to produce naïve offspring while there is still active PRRSV in the finishers. It is easy to “carry” PRRS virus from infected or vaccinated animals to naïve animals on a single site unit due to the close proximity of the animals. Facility design must be examined closely for single site PRRS elimination. Finisher barn design must be arranged so that there can be a distinct separation and separate air space between barns so that virus is not transmitted from vaccinated or infected finisher population to naïve populations. A distinct separation between sow facilities and finisher facilities within the unit with strict biosecurity practices is necessary for success.

Biosecurity and conscientious employees become of utmost importance in these situations. Even though it is a single-site farm, it must be treated as two sites during an elimination project to prevent virus transmission from the vaccinated or exposed pig populations to the naïve population. This may include clothing changes and/or showers when going between these two populations of animals.

There are many aspects to keep in mind and consider when undertaking a PRRSV elimination project. Protocol design includes all of these aspects and requires a good knowledge and understanding of the virus. The main goal of a PRRSV elimination protocol must be to eliminate the virus in as short of a time period as possible with minimal disruption of pig flow. It is also essential to remember that each farm must be considered on an individual basis and a farm-specific protocol must be devised based on facility design, serological results and personnel.

References


