Application of MJPRRS™ vaccine for PRRS control and elimination

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Introduction

In late 2006 and early 2007, a group of Minnesota swine veterinarians began working together to control PRRS risk for client herds in a four county area of Minnesota. We shared epidemiologic information and PRRSV sequences across our practice areas. With analysis of the information based on MJPRRS™ Grouping method we collaborated to produce the antigen concentrate vaccine (MJPRRS™) with PRRS isolates obtained from our local area[1] and evaluated the novel vaccine.

Difficulty in controlling PRRS and preventing re-breaks of PRRS infection with new or different strains of PRRS has been a common problem. Proper use and application of serum exposure in the field is complicated when a herd has gone through a single PRRS outbreak and prior to fully eliminating the virus experiences a new PRRS virus infection. Most practitioners and even seasoned veterinarians have difficulty implementing the steps necessary to make this a workable solution. Despite rigorous training methods,[2,3] there are still practical limitations to on-going use of serum exposure for herds infected simultaneously with multiple strains.

Our starting point for collaboration was the frequent failure to control PRRS outbreaks and not know what risk our clients were collectively experiencing as changes occurred dynamically in each practice area. By sharing information across practice areas and across this geographic area, we were able to evaluate the circulating "immunologic groups" of PRRS viruses.

Through collaboration with Dr. B.K. Kim, a chief scientist with MJ Biologics, Mankato, MN, we were able to review and group the PRRS viruses found to be epidemiologically important and utilize the grouping to produce a 4 PRRSV antigen concentrate vaccine (killed vaccine) known as MJPRRS™. We used this vaccine in herds during summer and fall of 2007, and in fall 2007 progressed to formulation of a 5-strain MJPRRS™ vaccine.[4]

This evaluation lead quickly to an adaptation of the PRRS virus strains selected to be part of the candidate vaccine. From the information in Table 1, it is readily apparent that if there were to be two vaccines, each with a MAJOR and MINOR composition, the vaccines may be produced in a manner that could facilitate broader usage within our production system to provide full immunologic coverage. Other approaches could also work by using MAJOR 1 and MAJOR 2 composite vaccines from two production systems, for example.

Table 2 shows how the MAJOR and MINOR composite vaccines may be formulated for our herds in IA/MN and the actual MAJOR composition we arrived for herds in our geographic area.

It is also important to note that the production system where the vaccine is applied should be the focus for successful PRRS control and elimination. These data suggest that individual production systems (or farms) may require dramatically different PRRSV strains in the vaccine compared to the "average" IA/MN area.

Characteristics of the vaccine

This vaccine can be characterized as (a) antigen concentrate, (b) it is killed, (c) is allows polyvalent (multi-group) strains and (d) is produced as an autogenous vaccine. Through autogenous vaccine regulations, the vaccine is made for individual herds through the growth of field PRRS virus isolates which have been selected from the herds history and sequence data based on MJPRRS™ Grouping method.

As an autogenous vaccine, the herd veterinarian must do several things in order to produce and use the vaccine. The vaccine is currently manufactured by MVP Laboratories at Omaha, NE using MJ Biologics' technology. The vaccine used by our collaboration group has been made from 5 field isolates, representing virus groups of D-1, D-4, D-5, S-1 and S-5. These groups cover > 90% of the PRRSV isolates for our practice area and also for non-adjacent herds in Minnesota/Iowa as analyzed by MJ Biologics. We have found no E-group viruses in our area.

Methods: Herd vaccination protocols

The process of adapting the killed, antigen concentrate, polyvalent PRRS started with our application to some specific small farms and evaluation during 2007-2008 for *control* of PRRS clinical signs. It was quite helpful

Table 1: PRRS Sequences (2005-2008 isolates)[5] converted to MJPRRS™ Grouping method

Group	Sub-group	Occurrence of viruses x region			Top 10 most common		
		IA/ MN	Remaining states	Entire US	IA/MN	Remaining states	Entire US
D	1	259	131	390	3	1	2
	2	39	14	53	9	6	10
	3	19	16	35		5	
	4	443	60	503	1	2	1
	5	156	14	170	6	6	5
	6	77	13	90	8	8	8
	7	163	2	165	5		6
	8	15	2	17			
S	1	327	17	344	2	4	3
	2	172	8	180	4	9	4
	3	35	21	56	10	3	9
	4	21	4	25			
	5	150	7	157	7	10	7
	6	32	5	37			
	7	5	0	5			
	8	2	0	2			
E	ALL (1-8)	15	20	35			
TOTAL		1930	334	2264			

initially to have the evaluation of the same composite vaccine in multiple farms. Collective clinical response allowed us to gain confidence in the vaccine and apply it further to stabilization of PRRS status on sow units and to propose a method for elimination using herd level strategic vaccination.

Stabilization: To stabilize a PRRS positive sow farm and to produce PRRSV PCR negative pigs at weaning, we applied the vaccine using the following protocol. Inherent in this definition, a PRRS positive sow farm was one where the herd sow had been exposed to PRRSV via gilt acclimation, or natural infection or serum exposure to control a natural infection. We did not use the vaccine in this manner if the herd was PRRS naïve and was experiencing an acute PRRS outbreak for the first time. Protocols will be presented for sow, gilt and piglet vaccination. Use of the MJ Biologics PRRS vaccine in this manner has resulted in very rapid improvement of reproductive results in breeding herd, and has led to PRRSV negative (PCR) weaned pigs within as little as 5 weeks form implementation of the herd vaccination.

As a tool for stabilization of a sow unit and production of PRRSV-PCR negative weaned pigs, the MJPRRS™ vaccine has been very beneficial. A major accomplishment in our control of PRRS using this tool has been the discontinuation of two aspects of serum exposure:

1. No longer using live virus exposure of the breeding herd except GDU, in the herd where that was necessary.
2. For new outbreaks in positive herds, we formerly used serum exposure to regain stability. We are using the MJPRRS™ vaccine as a polyvalent tool to avoid re-inoculation of the herd if new clinical signs occur.

We feel this is a major break-through. The clinical observations made lead us to believe that we are able to achieve a rapid and thoroughly neutralizing immune response which can be achieved in the adult breeding sows, gilts and boars. We also feel that clinically we are achieving a strong passive immunity passed from sow and gilts vaccinated with MJPRRS™ prior to farrowing through colostrum to the piglets. We would like to take steps to measure and adjust our vaccination strategy based on

Table 2: Theoretical and actual vaccine coverage using a MAJOR and MINOR vaccines

Vaccine	Vaccine	D-subgroups	S-subgroups	% of total isolates
IA/MN ranked	Major	1,4,7	1,2	70.7%
	Minor	2,5,6	3,5	23.7%
	Overall			94.4%
System 1	Major	1,4,5	1,5	69.2%
	Minor	2,6,7	2,3	25.2%
	Overall			94.4%
System2	Major	4,5,7	1,5	64.2%
	Minor	1,2,6	2,3	30.2%
	Overall			94.4%

optimizing passive transfer of immunity, but so far on a clinical basis this has worked remarkably well.

We have a few documented cases of which herds have different group of resident PRRSV strain compared to what is present in the vaccine. In these cases, we have seen a good response in the breeding herd, and improvement in the general pig performance post-weaning. We have not in these cases been able to neutralize virus completely, and pigs in the nursery are viremic when monitored closely. Therefore, use of vaccine containing the same group of virus to the current resident PRRSV is important to achieve the goal.

The steps towards PRRS elimination

PRRS stabilization has been successful using the concepts of herd exposure, recovery and closure for a pre-determined period of 180-240 days. By having full exposure, an accurate estimation of the duration of shedding and establishment of some boundaries for safety were possible. In contrast to stabilization, what we are focused on with "elimination" method is a logical pathway to follow towards a PRRS ELISA negative breeding herd, which is PCR negative on sows and weaned piglets and which can introduce a PRRS naïve gilt safely.

We need a herd level monitoring tool, in addition to the identification or achievement of PRRSV – PCR negative weaned pigs, and absence of clinical signs. We want to physically monitor ELISA levels, as a more sensitive way to see the entire breeding herd and its status during the elimination period.

Implementation at the sow unit depends on the intervention point and time from last acute PRRS outbreak. We estimated that we would need to implement a 2-year program for quarterly vaccination and monitor herd by herd to see what attributes lead to success or caused risk and possible failure.

At the onset, our plan was basically to: (1) Intervene, (2) Standardize gilt flow and acclimation (3) Boost sow unit quarterly for a period of up to 2 years based on roll over period for subpopulations with different virus exposure history. This protocol involves quarterly whole herd vaccination, rather than pre-farrowing vaccination used in "stabilization" approach.

What constitutes a successful elimination?

With respect to a single herd, successful elimination is proposed using the key elements below. On a clinical note, our veterinary group and clients are seeing the benefits of a thorough planned use of the vaccine and we feel that reduction in prevalence of infected pigs has already been gained.

Our phases outline for demonstrating or proving success depends on these four areas:

1. Ability to produce and maintain production of PRRSV PCR negative pigs for > 12 months, continuously without setbacks or episodes of virus presence in pigs.
2. Ability to control and prevent clinical signs of PRRS for > 52 weeks as evidenced by:
   a. Absence of PRRS-associated abortions or reproductive failure
   b. Absence of PRRS circulation in breeding herd as evidenced by combining Herd-level ELISA and PCR monitoring program (30 samples, monthly).
3. Extension of 1 and 2 to 2 year period of time.
4. Ability to introduce PRRS naïve gilts, unvaccinated

and leave within the herd for > 60 days with no evidence of PRRSV serologic response of ELISA and PCR positive results, measured at 60 days and > 90 days post entry.

An update on the status of individual farms will be presented with progress through these "phases".

Future: Successful elimination applied system-wide or regionally

A proposed method for extending successful elimination from the individual herd to entire production systems through non-adjacent herds may be to alter the quarterly vaccination program to provide alternating use of MAJOR and MINOR vaccine compositions for the sow herds, and post-weaning production as a means of conferring immunity across a broad range of expected PRRS viruses present.

If our greatest threat to successful long-term elimination of PRRS virus is "re-breaks" or re-infection of herds which have successfully completed elimination of one virus, then this method should make rational sense. The caveat is to prove the concept and successfully demonstrate the individual herd level and graduate the program to small regional herds and then to production systems and possibly to larger regions under non-adjacent rules.

Duration of immunity and other parameters of the composite vaccine will become more readily understood and appreciated as herds implement and challenge the notion of cross-protection vs. multiple variable PRRSV strains.

The ability to use vaccine as a polyvalent/multi-strain group composition has allowed greater flexibility for our veterinary group to approach immune stimulation and has been of critical importance in implementing this tool in a wider area.

Summary

Application of a killed antigen concentrated polyvalent vaccine for the elimination of PRRS from a breeding herd population is not difficult to envision, considering the current state of the industry and our need for a more economical and effective PRRS virus vaccine (vs. current modified live formulations). The continued emergency of strains of increased virulence or which escape the normally developed and protective neutralizing immune response clearly demonstrates a need for work in this area.

Our group acknowledges the tremendous help we have had from researchers at MJ Biologics, university diagnostic labs and fellow veterinarians in collaborating on progress thus far. Further work will be needed, but we feel that this method and vaccine has improved our process for control and elimination of PRRS.

References

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