

ANNUAL REPORT PROJECT NC-229

PERIOD COVERED: June 2008 to November 2009

INSTITUTION OR STATION: Kansas State University

A. NC-229 REPRESENTATIVE:

Rowland, Raymond RR, Kansas State University, browland@vet.k-state.edu

Other PRINCIPLE LEADERS associated with the projects

KSU researchers

Wyatt, Carol K-State

Hesse, Dick, K-State

Sang, Yongming, K-State

Chang, KC, K-State

Blecha, Frank, K-State

Other collaborators outside of K-State

Zimmerman, Jeffery, ISU

Lunney, Joan, BARC

Calvert, Jay, Pfizer Animal health

Nelson, Eric, SDSU

Fang, Ying, SDSU

Roof, Mike, BIV

Yoo, Dongwan, UI

McIntosh, Michael, PIADIC

Wong, Susan, NY

B. PROGRESS OF WORK AND PRINCIPAL ACCOMPLISHMENTS:

Objective 1. Elucidate the mechanisms of host-pathogen(s) interactions.

Sang, Blecha and Rowland performed a study identifying 39 type I IFN genes. Recombinant IFN proteins show a wide range of activities, including some novel IFNs that are effective in controlling PRRSV replication.

Hesse and Rowland are performing an analysis of cross-protection between diverse PRRSV strains.

Objective 2. Understand the ecology and epidemiology of PRRSV and emerging viral diseases of swine.

In collaboration with Lunney (BARC) and others, Rowland and Hesse participated in the PRRS Host Genetics Consortium. The results for the year include the infection and sample collection of 400 pigs at K-State. The results reveal the appearance of stratified subpopulations which possessed wide variations in weight, virus load and growth performance.

Objective 3. Develop effective and efficient approaches for detection, prevention and control of PRRSV and emerging viral diseases of swine.

Along with several others, Rowland and Hesse are incorporating Luminex for the detection of IgM and IgG antibodies to PRRSV and other pathogens. The results provide the opportunity to develop assays for the purpose of profiling multiple agents within a herd.

C. IMPACT AND VALUE OF RESEARCH TO STAKEHOLDERS:

Genetic analysis of host response has revealed the diverse negative impacts of PRRSV on a population. Decreased performance is a loss to the producer's "bottom line". New IFN genes that possess potent anti-PRRSV can be incorporated into vaccines and other antiviral therapies.

Luminex provides the means to 1) detect antibodies to multiple agents in a single small volume of sample, 2) increase sensitivity and specificity, 4) reduce the cost of testing, and 5) semi-quantitative output without need for serial dilution of a sample to an endpoint, and 5) test for agents in non-serum samples, such as oral fluids and meat juice.

Rowland and Hesse, 2009-2111. USDA NRI 2009-35204-05290, Mapping host protective immunity in the PCV2 capsid protein, \$240,000.

Hesse and Rowland, 2009, Fort Dodge Animal Health, Heterotypic immunity as a platform for a new generation of modified live PRRS vaccines. \$100,000

Rowland and Hesse, NPB, 2008-2009, The role of maternal antibody in determining PCV2 vaccine efficacy. \$32,000

Wyatt et al., NPB, 2008-2009, Mapping T cell epitopes in the PCV2 capsid protein. \$58,000.

D. PRRS PUBLICATIONS ISSUED OR "IN PRESS"

1) Refereed publications

Wenjun Ma, AL Vincent, KM Lager, BH Janke, SC Henry, RRR Rowland, RA Hesse, JA Richt. 2009. Identification and characterization of a highly virulent triple reassortant H1N1 swine influenza virus in the United States. *Virus Genes*, in press.

Mohammadi, H, S Sharif, RRR Rowland, D. Yoo. 2009. The lactate dehydrogenase-elevating virus capsid protein is a nuclear-cytoplasmic protein. *Arch Virol*. 154:1071-1080.

Sang, Y, P Ruchala, R Lehrer, CR Ross, RRR Rowland, Frank Blecha. 2009. Antimicrobial Host Defense Peptides in an Arteriviral Infection: Differential Peptide Expression and Virus Inactivation. *Viral Immun.* Accepted for publication.

- Brown E, S Lawson, C Welbon, J Gnanandarajah, J Li, MP Murtaugh, Nelson EA, RM Molina, JJ Zimmerman, RR Rowland, Y Fang. 2009. Antibody response of nonstructural proteins: implications for diagnostic detection and differentiation of Type I and Type II porcine reproductive and respiratory syndrome viruses. *Clin Vaccine Immunol*. In press.
- Molina, RM, EA Nelson, J Christopher-Hennings R Hesse, RR Rowland, JJ Zimmerman. 2008. Evaluation of the risk of PRRSV transmission via ingestion of muscle from persistently infected pigs. In press *Transbound Emerg Dis*.
- Kim, DY, TJ Kaiser, K Horlen, ML Keith, LP Taylor, R Jolie, JG Calvert, RR Rowland. 2008. Insertion and deletion in a non-essential region of the nonstructural protein 2 (nsp2) of porcine reproductive and respiratory syndrome (PRRS) virus: effects on virulence and immunogenicity. In press *Virus Genes*.
- Gaudreault, N, RR Rowland, CR Wyatt. 2009. Factors affecting the permissiveness of porcine alveolar macrophages for porcine reproductive and respiratory syndrome virus. In press *Archiv Virol*.
- Ho, C-S, Y-J Lee, JK Lunney, MH Franzo-Romain, GW Martens, J-H Lee, M Wysocki, RRR Rowland, DM Smith. 2009. Molecular characterization of swine leukocyte antigen (SLA) class I genes in outbred pig populations". Accepted for publication *Anim Genetics*
- Molina RM, S Cha, W Chittick, S Lawson, MP Murtaugh, EA Nelson, J Christopher-Hennings, K-J Yoon, R Evans, RRR Rowland, J Zimmerman. 2008. Immune response against porcine reproductive and respiratory syndrome virus during acute and chronic infection. *Vet Immunol Immunopathol* 126:283-292.
- Patton, JP, RRR Rowland, D Yoo and K-O Chang. 2008. Modulation of CD163 receptor expression and replication of porcine reproductive and respiratory Syndrome virus in porcine macrophages. Accepted for publication *Virus Res*.
- Molina, R, W Chittick, E Nelson, J Christopher-Hennings, RRR Rowland, JJ Zimmerman. 2008. Diagnostic performance of assays for the detection of anti-PRRSV antibodies in porcine muscle transudate ("meat juice") samples. *J Vet Diag Invest*. Accepted for publication.
- Sang, Y, C Ross, RR Rowland, F Blecha. 2008. Toll-like receptor 3 (TLR3) activation decreases porcine arterivirus infection. *Viral Immunol* 21:303-313.
- Sang, Y, J Yang, C Ross, RRR Rowland, and F Blecha, 2008. Molecular identification and functional expression of porcine Toll-like receptor (TLR) 3 and TLR7. In press *Vet Immunol Immunopath*.

2) Abstracts or Proceedings

- Potter, ML, S Dritz, R Hesse, R Rowland, J Nietfeld, R Oberst. 2008. Porcine Circovirus Type 2 elimination study. 2008 American Association of Swine Veterinarians Meeting. San Diego.
- Potter, ML, LM Tokach, SS Dritz, SC Henry, JM DeRouchey, MD Tokach, RD Goodband, JL Nelsen, RR Rowland, RD Hesse, RA Hesse. 2008. Genetic background influences pig growth rate responses to porcine circovirus type 2 (PCV2) vaccines. 2008 KSU Swine Day.
- Hesse, R, R Rowland. 2008. Circovirus Vaccination Decisions: Herd Profiling and Next Generation Diagnostic Testing. 2008 Leman Swine Conference, St Paul, MN.
- Wong, SJ, R Hesse, R Rowland. Application of multiplex microsphere immunoassay techniques to the diagnosis of PRRSV and other infectious. 2008 International PRRS Symposium, Chicago.

- Sang, Y, P Ruchala, RI Lehrer, CR Ross, RRR Rowland, F Blecha. 2008. Antimicrobial host defense peptides in an arteriviral infection: differential expression and inactivation of PRRSV. 2008 International PRRS Symposium, Chicago.
- Trible, B, JG Calvert , RRR Rowland. 2008. Expression of enhanced green fluorescent protein (EGFP) in nonstructural protein 2 (nsp2) of PRRSV shows loss of fluorescence without affecting EGFP immunogenicity.
- Lunney, JK, M Wysocki, D Kuhar, JP Steibel, CW Ernst, M McCaw, RRR Rowland. 2008. Genetic control of swine responses to porcine reproductive and respiratory syndrome virus infection. Pig Genome II conference, Ljubljana, Slovenia, June, 4-5, 2008
- Lunney, JK, M Wysocki, D Kuhar, JP Steibel, CW Ernst, M McCaw, RRR Rowland. 2008. Genetic control of swine responses to porcine reproductive and respiratory syndrome virus infection. Abstract for International Society for Animal Genetics (ISAG 2008) in Amsterdam, The Netherlands in July 20-24, 2008.
- Lunney, JK, M Wysocki, D Kuhar, JP Steibel, CW Ernst, M McCaw, RRR Rowland. 2008. Plans for analyses of swine responses to PRRSV infection; our lab, NC229, and USDA funded PRRS CAP2. EuroPRRSNet meeting in Brussels, Belgium, in July 24-25, 2008.
- Rowland, R, S Henry, S Dritz, R Hesse. 2008. Epidemiology of PCV2 and PCVAD. 2008 American Association of Swine Veterinarians, San Diego.
- Rowland, R, R Hesse, K Horlen. 2008. Porcine circovirus vaccine trials: from the laboratory bench to the field. George Young Swine Conference, Sioux City.
- Rowland, R. 2008. PRRS vaccines. 2008 Leman Swine Conference, St Paul, MN.
- Rowland, R. 2008. Mapping host protective immunity in the PCV2 capsid protein. USDA NRI Principal Investigators Meeting, Chicago.

3) Book chapters or monographs

E. FUNDING SOURCES FOR PRRSV RESEARCH

- Hesse and Rowland, 2009, Fort Dodge Animal Health, Heterotypic immunity as a platform for a new generation of modified live PRRS vaccines. \$100,000
- Rowland et al., USDA NRI Coordinated Agricultural Program (CAP), 2008-2012. Integrated strategies to control and reduce the impact of PRRS virus control, \$4.8 million.
- Blecha, et al, USDA NRI, 2006-2009. Porcine antimicrobial peptides and Toll-like receptors in PRRS pathogenesis, \$340,000.
- Lunney et al., NPB, 2007-2008. PRRS host genetics consortium: A proposal to develop a consortium to study the role of host genetics and resistance to PRRSV. \$300,000.

F. WORK PLANNED FOR NEXT YEAR

Continue to perform work in the areas of innate immunity, diagnostics and host genetic resistance.