

ANNUAL REPORT PROJECT NC-229

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INSTITUTION OR STATION: Iowa State University

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B. PROGRESS OF WORK AND PRINCIPAL ACCOMPLISHMENTS:

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

1. New estimates of PRRSV persistency (up to 175 DPI)
2. New information on virus evolution indicates that persistent PRRSV infection does not depend on mutations in ORFs 1b, 5, or 7
3. Among a variety of antibody assays and ELISPOT, the SVN antibody response was the best predictor of both level and duration of viremia. Antibody responses (IDEXX ELISA, N ELISA, and M 3' ELISA) predicted prior exposure to PRRSV, but provided little information regarding the ontogeny of the protective immune response. ELISPOT was a poor prognosticator of PRRSV infection status.

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

1. New estimates of R_0 for PRRSV in different operations
2. Survival analysis of PRRSV transmission within herds
3. Overview of PRRSV routes of transmission and patterns of circulation
4. Continued work on PRRSV aerosols, including methods of inactivating airborne viruses
5. Research shows that PRRSV is difficult to transmit to susceptible pigs via consumption of meat from PRRSV-infected animals.

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

1. Extensive studies on the use of oral fluids for the detection of PRRSV, anti-PRRSV antibody, and other pathogens - a new highly cost-effective approach for surveillance PRRSV and other pathogens in commercial settings.

C. IMPACT AND VALUE OF RESEARCH TO STAKEHOLDERS:

Research advances over the last year continue to expand our understanding of PRRSV epidemiology, pathobiology, virology, and provide new ideas for countering and/or eliminating the infection. Extensive work has been done regarding the emergence of genetic and antigenic variation during replication in pigs and its role in persistence. Continued assessment and research in diagnostic technology contributes to the improvement and refinement of our ability to detect and diagnose PRRSV infection. On-going work on new methods of surveillance promise to provide new, highly cost-effective methods of tracking infection and implementing area elimination/eradication programs. Accomplishments in these areas linked with research in viral ecology/epidemiology, will lead to the development of tools that will result in the eventual elimination and eradication of PRRSV from individual farms and regions.

D. PRRS PUBLICATIONS ISSUED OR “IN PRESS”

1) Refereed publications

- Brown E, Lawson S, Welbon C, Gnanandarajah J, Li J, Murtaugh MP, Nelson EA, Molina RM, Zimmerman JJ, Rowland RRR, Fang Y. 2009. Antibody response of nonstructural proteins: implication for diagnostic detection and differentiation of Type I and Type II porcine reproductive and respiratory syndrome virus. *Clin Vaccine Immunol* 16:628-635.
- Chang C-C, Yoon K-J, Zimmerman JJ. 2009. Persistent porcine reproductive and respiratory syndrome virus (PRRSV) infection in pigs does not require significant genetic change. *J Swine Health Prod* 17(6):318–324.
- Hermann JR, Brockmeier SL, Yoon KJ, Zimmerman JJ. 2008. Detection of respiratory pathogens in air samples from acutely infected pigs. *Can J Vet Res* 72:367-370.
- Hermann JR, Muñoz-Zanzi CA, Zimmerman JJ. 2009. A method to provide improved dose-response estimates for airborne pathogens in animals: An example using porcine reproductive and respiratory syndrome virus. *Vet Microbiol* 133:297-302.
- Hermann JR, Zimmerman JJ. 2008. Analytical sensitivity of air samplers based on uniform point source exposure to airborne porcine reproductive respiratory syndrome virus and swine influenza virus. *Can J Vet Res* 72:440-443.
- Holtkamp DJ, Yeske PE, Polson DD, Melody JL, Philips RC. 2009. A prospective cohort study evaluating duration of breeding herd PRRS virus-free status and its relationship with measured risk. *Prev. Vet. Med.* (submitted).
- Holtkamp DJ., Yu L, Polson DD, O'Connor A. 2009. External and internal biosecurity factors associated with the occurrence of clinical PRRS breaks. *Vet Res* (submitted).
- Jacobs AC, Hermann JR, Muñoz-Zanzi C, Prickett JR, Roof MB, Zimmerman JJ. 2010. Thermostability of porcine reproductive and respiratory syndrome virus in solution. *J Vet Diagn Invest* 22: (in press).
- Kim W-I, Kim J-J, Cha S-H, Yoon K-J. 2008. Different biological characteristics between wild-type PRRS viruses and vaccine viruses and identification of the corresponding genetic determinants. *J Clin Microbiol* 46:1758-1768.
- Kim W-I, Yoon K-J. 2008. Molecular assessment of the role of envelope-associated structural proteins in cross neutralization among different PRRS viruses. *Virus Genes* 37:380-391.
- Lunney JK, Fritz ER, Reecy JM, Kuhar D, Prucnal E, Molina R, Christopher-Hennings J, Zimmerman J, Rowland RRR. 2010. Interleukin-8, interleukin 1 β and interferon- γ levels are linked to PRRS virus clearance. *Viral Immunol* (in press).
- Molina RM, Cha S-H, Chittick W, Lawson S, Murtaugh MP, Nelson EA, Christopher-Hennings J, Yoon K-J, Evans R, Rowland RRR, Wu W-H, Zimmerman J. 2008. Immune response against porcine reproductive and respiratory syndrome virus during acute and chronic infection. *Vet Immunol Immunopathol* 126:283-292.
- Molina RM, Chittick W, Nelson EA, Christopher-Hennings J, Rowland RRR, Zimmerman JJ. 2008. Diagnostic performance of assays for the detection of anti-PRRSV antibodies in meat transudate (“meat juice”) samples. *J Vet Diagn Invest* 20:735-743.
- Molina RM, Nelson EA, Christopher-Hennings J, Hesse R, Rowland RRR, Zimmerman JJ. 2009. Evaluation of the risk of PRRSV transmission via ingestion of muscle from persistently-infected pigs. *Transbound Emerg Dis* 56:1-8.

- Prickett J, Kim W-I, Simmer R, Yoon K-J, Zimmerman JJ. 2008. Surveillance of commercial growing pigs for PRRSV and PCV2 infections using pen-based oral fluid sample: a pilot study. *J Swine Health Prod* 16(2):86-91.
- Prickett J, Simer R, Christopher-Hennings J, Yoon K-J, Evans RB, Zimmerman JJ. 2008. Detection of porcine reproductive and respiratory syndrome virus infection in porcine oral fluid samples: A longitudinal study under experimental conditions. *J Vet Diagn Invest* 20:156-163.
- Ran ZG, Chen XY, Guo X, Ge NX, Yoon K-J, Yang HC. 2008. Recovery of viable porcine reproductive and respiratory syndrome virus from an infectious clone containing partial deletion within Nsp2-encoding region. *Arch Virol* 153:899-907.
- Yaeger M, Karriker L, Layman L, Halbur P, Huber G, Van Hulzen K. 2009. Survey of disease pressures in twenty-six niche herds in the Midwestern United States. *J Swine Health Prod*. 2009 17(5): 256-263.
- Yue F, Cui S, Zhang C, Yoon K-J. 2009. A multiplex PCR for rapid and simultaneous detection of porcine circovirus type 2, porcine parvovirus, porcine pseudorabies virus, and porcine reproductive and respiratory syndrome virus in clinical specimens. *Virus Genes* (in press)

2) Abstracts or Proceedings

- Carley D, Ramamoorthy S, Opreissnig T, Wong C, Tobin G, Yoon KJ, Halbur PG, Messel R, Nara PL. 2009. Evaluation of the PRRSV antibody response following vaccination with a proprietary autogenous vaccine. Proceedings, Summer Scholar Program.
- Carley D, Ramamoorthy S, Opreissnig T, Wang C, Tobin G, Yoon KJ, Halbur PG, Messel R, Nara PL. August 2009. Evaluation of the PRRSV antibody response following vaccination with a proprietary autogenous vaccine. Research Day, College of Veterinary Medicine, Iowa State University. Ames, IA.
- Carmichael BA, Polson DD, Torremorell M, Holtkamp DJ. 2009. Pre-colostral stillborn piglet blood sampling procedure when a PRRSV positive sow herd is being monitored for time-to-negative interval. 40th AASV Annual Meeting. Dallas, Texas.
- Cha S-H, Dorman KS, Kim W-I, Yoon KJ. 2008. Viral recombination among field isolates of PRRSV type 2 – implication for molecular epidemiology. PRRS Symposium.
- Cutler T, Hoff S, Wang C, Warren K, Zhou F, Qin Q, Miller C, Ridpath J, Yoon K-J, Zimmerman J. 2009. UV₂₅₄ Inactivation of Selected Viral Pathogens. 52st Annual Conference, American Association of Veterinary Laboratory Diagnosticians. San Diego, California, p. 124.
- Cutler T, Kittawornrat A, Hoff S, Wang C, Zimmerman J. 2009. Median infectious dose (ID₅₀) of PRRSV isolate MN-184 for young pigs via aerosol exposure. 52st Annual Conference, American Association of Veterinary Laboratory Diagnosticians. San Diego, California, p. 110.
- Dion KR, Dau D, Delks AM, Hammer M, Holtkamp DJ. 2009. Feed medication protocol comparison in a PRRSV unstable nursery flow. 40th AASV Meeting. Dallas, Texas.
- Dixon PM, Yoon K-J. 2008. Estimating the mutation rate when not all mutations are detected. Proceedings, Iowa State University Fall Conference on Statistics in Biology.
- Harms PA, Holtkamp DJ, Quirk Z. 2009. Management of, and costs associated with, false positive when monitoring presumed PRRS-negative herds. 40th AASV Annual Meeting, Pre-Conference Seminar, Managing PRRS Introduction into High Risk Populations. Dallas, Texas.

- Holtkamp DJ, Melody JL, Burkgren TJ. 2008. Update On The AASV Production Animal Disease Risk Assessment Program (PADRAP) and the New Web-based Application. 20th IPVS Meetings. Durban, South Africa. June. p. 01.66.
- Holtkamp DJ, Melody JL, MacDougald D. 2008. A comparison of PRRSV risks for Canadian and U.S. breeding herds. 20th IPVS Meetings. Durban, South Africa. June. p. 01.77.
- Holtkamp DJ, Polson DD. 2008. PRRS herd classification: Can we speak the same language? Carlos Pijoan International Symposium: New Solutions to Old Problems. Pre-Conference Workshop 2006 Allen D. Leman Swine Conference. St. Paul, Minnesota.
- Karriker L, Bowden J. 2009. PRRS virus vaccination strategies and efficacy. Proceedings of the George A. Young Swine Health and Management Conference. South Sioux City, Nebraska.
- Karriker L, Layman L, Yaeger M. 2008. Session 5531: Health challenges in niche production. Conference Notes CD of the 145th American Veterinary Medical Association Meeting. New Orleans, Louisiana.
- Karriker L. 2008. Session 5543: PRRSV: management strategies. Current swine disease trends. Conference Notes CD of the 145th American Veterinary Medical Association Meeting. New Orleans, Louisiana.
- Kim W-I, Bower L, Strait E, Harmon K, Yoon K-J. 2009. Simultaneous detection of multiple pathogens using high-throughput nanoliter real-time PCR. AAVLD.
- Kim W-I, Cho Y-I, Harmon K, Madson D, Opriessnig T, Yoon K-J. 2008. Comparison of three extraction methods for the detection of PCV2 and PRRSV in semen. AAVLD.
- Kim W-I, Sun D, Cho Y-I, Liu S, Cooper V, Yoon K-J. 2009. Identification of molecular markers for virulence of porcine reproductive and respiratory syndrome (PRRS) virus. AAVLD
- Kim W-I, Sun D, Cho Y-I, Liu S, Loynachan AT, Cooper VC, Yoon KJ. 2009. Genetic determinants associated with the virulence of PRRSV in pigs. AASV.
- Koziel JA, Yang X, Cutler T, Zhang S, Zimmerman J, Hoff S, Jenks WS, van Leeuwen JH, Laor Y, Ravid U, Armon R. 2008. Treatment of livestock odor and pathogens with ultraviolet photocatalysis. Proc AgEng 2008 International Conference on Agricultural Engineering and Industry Exhibition, (Abstr OP-575). Hersonissos, Greece.
- Koziel JA, Yang X, Zhang S, Cai L, Hoff SJ, Leeuwen HJ, Cutler T, Zimmerman J, Jenks WS, Laor Y, Ravid U, Armon R. October 2008. Treatment of livestock odor and pathogens with ultraviolet photocatalysis. Proc 3rd IWA Odour and VOCs Conference. Barcelona, Spain.
- Liu S, Kim W-I, Ramamoorthy S, Yoon K-J. 2009. Alternative assays and testing algorithm for confirmation of suspect false positives in a commercial ELISA for PRRSV. AAVLD.
- Molina RM, Cha S-H, Rowland RRR, Christopher-Hennings J, Nelson E, Lunney J, Yoon K-J, Zimmerman JJ. 2008. Factores involucrados en la persistencia del virus de síndrome respiratorio porcino (PRRS). Memorias XXI Congreso Panamericano de Ciencias Veterinarias. Guadalajara, México, pp. 533- 534.
- Prickett J, Cutler S, Kinyon J, Naberhaus N, Stensland WR, Yoon K-J, Zimmerman J. 2008. PRRSV surveillance – Stability of diagnostic targets in oral fluid: sample storage and critical techniques for testing. Proc 89th Ann Meet Conference of Research Workers in Animal Diseases, Abstr #38.
- Prickett J, Cutler S, Kinyon J, Naberhaus N, Stensland WR, Yoon K-J, Zimmerman J. 2008. PRRSV surveillance – Stability of diagnostic targets in oral fluid: sample storage and critical techniques for testing. Proc 2008 International PRRS Symposium. Chicago, Illinois, p 26.

- Prickett J, Hoffmann P, Main R, Sornsen S, Johnson J, Zimmerman J. 2009. Cost-effective PRRS surveillance. Proceedings of the American Association of Swine Veterinarians. Dallas, Texas, pp. 467-469.
- Prickett J, Hoffmann P, Main R, Stensland W, Yoon K-J, Zimmerman J. 2008. Practical disease surveillance in growing pig populations. Proc 89th Ann Meet Conference of Research Workers in Animal Diseases, Abstr #39.
- Prickett J, Hoffmann P, Main R, Stensland W, Yoon K-J, Zimmerman J. 2008. Practical disease surveillance in growing pig populations. Proc 2008 International PRRS Symposium. Chicago, Illinois, p 27.
- Prickett J, Zimmerman J. 2008. Practical disease surveillance in growing pig populations. Proceedings, Welfare and Epidemiology Conference: Across Species, Across Disciplines, and Across Borders. Ames, Iowa, p. 22.
- Prickett J, Zimmerman J. 2009. Practical disease surveillance in growing pig populations. J Appl Anim Welf Sci 12:156.
- Prickett JR, Cutler S, Kinyon J, Naberhaus N, Stensland W, Yoon KJ, Zimmerman J. 2008. PRRSV surveillance - Stability of diagnostic targets in oral fluid: sample storage and critical techniques for testing. Proc 51st Annual Conference, American Association of Veterinary Laboratory Diagnosticians. Greensboro, North Carolina, p. 140.
- Prickett JR, Cutler S, Kinyon J, Naberhaus N, Stensland W, Yoon K-J, Zimmerman J. 2008. PRRSV surveillance - stability of diagnostic targets in oral fluid: Sample storage and critical techniques for testing. Proc 47th North Central Conference of Veterinary Laboratory Diagnosticians. Madison, Wisconsin, pp. 8.
- Prickett JR, Cutler S, Kinyon J, Naberhaus N, Stensland WR, Yoon K-J, Zimmerman JJ. 2008. PRRSV surveillance – stability of diagnostic targets in oral fluid: sample storage and critical techniques for testing. AAVLD.
- Prickett JR, Cutler S, Kinyon J, Naberhaus N, Stensland WR, Yoon K-J, Zimmerman JJ. 2008. PRRS surveillance – Stability of diagnostic targets in oral fluid: Sample storage and critical techniques for testing. NCCVLD.
- Prickett JR, Hoffmann P, Main R, Sornsen S, Johnson J, Zimmerman J. 2008. Infectious disease surveillance in commercial swine populations. Proceedings 16th Annual Swine Disease Conference for Swine Practitioners, Iowa State University. Ames, Iowa, pp. 40-44.
- Prickett JR, Hoffmann P, Main R, Stensland W, Yoon K-J, Zimmerman J. June 2008. Practical disease surveillance in growing pig populations. Proc 47th North Central Conference of Veterinary Laboratory Diagnosticians. Madison, Wisconsin, pp. 10.
- Prickett JR, Hoffmann P, Stensland W, Yoon KJ, Zimmerman J. 2008. Practical disease surveillance in growing pig populations. Proc 51st Annual Conference, American Association of Veterinary Laboratory Diagnosticians. Greensboro, North Carolina, p. 139.
- Sun D, Kim W, Cho Y, Cooper V, Cha S, Kim S, Choi E, Yoon K. 2009. Role of viral structural proteins in conferring protective immunity against PRRSV and its application to the development of vaccine candidates for broad cross-protection. AASV.
- Sun D, Kim W-I, Cho Y-I, Cha S-H, Kim S-H, Choi E-J, Yoon KJ. 2008. Cross-protection induced by chimeric mutant containing mixed structural genes of two different PRRS viruses. CRWAD.
- Sun D, Kim W-I, Cho Y-I, Yoon KJ. 2008. Attempt to achieve broader cross-protection among PRRS viruses by vaccination: use of chimeric mutant containing mixed structural genes of two different PRRS viruses. PRRS Symp.

- Vu HLX, M. Brito M, Kim WI, Yoon KJ, Laegreid W, Osorio FA. 2008. Sub-typing PRRSV isolates by means of measurement of cross neutralization reactions. CRWAD.
- Vu HLX, M. Brito M, Kim WI, Yoon KJ, Laegreid W, Osorio FA. 2008. Sub-typing PRRSV isolates by means of measurement of cross neutralization reactions. PRRS Symp.
- Waddell JM, Melody JL, Holtkamp DJ. 2009. Investigation of associations between risk factors, reported clinical PRRS breaks and reproductive performance in swine breeding herds. Proc. 40th AASV Annual Meeting. Dallas, Texas.
- Waddell JT, Polson DD, Holtkamp DJ. 2008. Assessment of changes in breeding herd PRRS site risk scores in a large production system over a three-year period. Proc 20th IPVS Meetings. Durban, South Africa. p. 01.135.
- Yang X, Koziel JA, Cutler T, Zhang S, Zimmerman J, Hoff SJ, Jenks W, van Leeuwen J, Harmon J, Faulhaber C, Laor Y, Ravid U, Armon R. 2008. Treatment of livestock odor and pathogens with ultraviolet light. American Society of Agricultural and Biological Engineers (ASABE) Paper No. 085198. ASABE Annual International Meeting. Providence, Rhode Island.
- Yoon K-J. 2008. PRRS diagnosis as tool for evidence-based PRRS control. KASV.
- Zimmerman J, Prickett J, Johnson J. 2009. Oral fluid testing: Science-based applications. Carlos Pijoan International Symposium: New Approaches to Herd Diagnostics. Allen D. Lemans Swine Conference. St. Paul, Minnesota, pp. 11-14.
- Zimmerman J, Prickett J, Johnson JH, Molina R. 2009. Evaluando fluidos orales: Base científica de su aplicación. XVIII Día del Porcicultor 2009. Asociación de Médicos Veterinarios Zootecnistas Especialistas en Ciencias Porcícolas del Sur de Sonora A.C. Navojoa, Sonora, Mexico (CD - no page numbers).
- Zimmerman J, Prickett J. 2008. Future epidemiologic / ecologic methods. 1st Annual Boehringer Ingelheim Swine Academy. Ames, Iowa, Vol 1, pp. 251-260.
- Zimmerman J, Prickett JR, Molina R, Hoffmann P, Main R, Sornsen S, Johnson J. 2008. Vigilancia epidemiológica de enfermedades infecciosas en poblaciones porcinas comerciales utilizando fluidos orales. Memorias XXI Congreso Panamericano de Ciencias Veterinarias. Guadalajara, México, pp. 231-234.
- Zimmerman J. 2009. The Big Picture: Infectious disease, oral fluid testing, and swine health. 2nd Annual Boehringer Ingelheim Swine Academy. Ames, Iowa, pp. 181-200.

3) Book chapters or monographs

4) Poster presentations

- Prickett J, Cutler S, Kinyon J, Naberhaus N, Stensland WR, Yoon K-J, Zimmerman J. December 2008. PRRSV surveillance – Stability of diagnostic targets in oral fluid: sample storage and critical techniques for testing. Proc 2008 International PRRS Symposium. Chicago, Illinois, p 26.
- Prickett J, Hoffmann P, Main R, Stensland W, Yoon K-J, Zimmerman J. December 2008. Practical disease surveillance in growing pig populations. Proc 2008 International PRRS Symposium. Chicago, Illinois, p 27.

E. FUNDING SOURCES FOR PRRSV RESEARCH

1) Current

- Faaberg KS, Collins JE, Yoon K-J, Christopher-Hennings J, Crow JA, Leung FC. 09/01/07-08/30/08. Implementation of a PRRSV strain database. National Pork Board PRRS Initiative. \$51,322.
- Fang Y, Zimmerman J, Christopher-Hennings J, Nelson E, Murtaugh M, Lunney J. 01/01/10 to 12/31/11. Development of diagnostic assays for detecting PRRSV infection using oral fluid samples as an alternative to serum-based assays. National Pork Board - \$99,989.
- Holtkamp D, Ramirez A, O'Connor A, Zimmerman J. 01/01/09 to 12/31/09. Assessment of PRRS biosecurity in the field: Application of the American Association of Swine Veterinarian's PRRS Risk Assessment Tool. USDA:CSREES National Research Initiative, Competitive Grants Program 230.1 Animal and Plant Biosecurity (subcontract: Kansas State University) - \$24,300.
- Holtkamp D, Zimmerman J. 10/01/08 to 09/30/09. Quantifying risk factors for PRRSV introduction into swine herds through the use of the PRRS Risk Assessment Tool. National Pork Board - \$89,875.
- Holtkamp D.J. A Cross-sectional Study Of PRRSV Positive Swine Breeding Herd Sites To Evaluate Associations Between Risk Factors And A Case Definition-based Number And Severity Of Clinical Prrs Episodes. Boehringer Ingelheim Vetmedica Inc. \$115,000. Continuation of previous grant with same title. January 6, 2009.
- Kim W-I, Yoon K-J, Cooper VC. 11/01/07-10/30/08. Identification of protective epitopes toward developing a vaccine providing broad cross-protection among PRRS viruses. National Pork Board PRRS Initiative. \$89,150.
- Kim W-I, Yoon K-J. 7/1/08-6/30/10. A new approach to PRRS vaccine that confers cross-protection against a broader range of PRRS viruses using chimeric mutant PRRS viruses. Iowa Healthy Livestock Initiative Research Grant. \$39,980.
- Lunney J, Christopher-Hennings J, Nelson E, Fang Y, Steibel JP, Zimmerman J. 01/01/10 to 12/31/11. Comparison of early immune responses of pigs which are genetically PRRS resistant/tolerant using a swine-specific immune protein (cytokine) multiplex assay. National Pork Board - \$103,929.
- Yoon K-J. 1/1/07-12/31/10. Development of surveillance program and vaccine for PRRS in Korea: Development of a differential test for PRRS vaccine virus and immunological study of viral factors for protective immunity. Korean Ministry of Agriculture and Forestry (c/o National Veterinary Research and Quarantine Service). \$280,000.
- Zimmerman J, Dee SA, Davies PR, Holtkamp DJ, O'Connor A. 08/01/09 to 07/31/10. Identifying ecologic and epidemiologic factors in the control of PRRS: A field-based approach. USDA:CSREES National Research Initiative, Competitive Grants Program 230.1 Animal and Plant Biosecurity (subcontract: Kansas State University) - \$116,991.
- Zimmerman J, Hoff SJ. 07/01/09 to 06/30/10. Effect of temperature and humidity on ultraviolet (UV) inactivation of airborne PRRS virus. Innovative Swine Industry Enhancement Grant Program, Iowa Attorney General's Office - \$43,046.
- Zimmerman J. 05/01/09 to 04/31/10. PRRS CAP Graduate and Undergraduate Scholar Program Application - Iowa State University. USDA:CSREES National Research Initiative, Competitive Grants Program 230.1 Animal and Plant Biosecurity (subcontract: Kansas State University) - \$23,999. Gold Sheet #97704.

F. WORK PLANNED FOR NEXT YEAR

- Continue research on identifying the most important biosecurity factors for maintaining PRRS virus negative swine populations.
- Continue development of the Production Animal Disease Risk Assessment Program (PADRAP), including the PRRS Risk Assessment for the Breeding Herd and PRRS Risk Assessment for the Growing Pig Herd.
- Functional genomics of PRRS viral protection and pathogenesis
- Continue research on the immunobiology of PRRSV, including vaccine development.
- Continue work on improved diagnostics for PRRSV
- Continue work on improved surveillance for PRRSV and co-infections.