



Technicians and students working on the project at the Deschambault test station in Quebec. Photo: CDPQ

New tools to enable effective genomic selection for disease resilience

► Graham Plastow, University of Alberta

Project Status: Completed in 2018

Genetics plays a significant role when infection or disease occurs in an animal. In this project, researchers identified several genomic regions that may contribute to the susceptibility and/or the resilience of the swine fetus against viral infection when the pregnant sow is infected with PRRS (porcine reproductive and respiratory syndrome) virus.

Also, initial results from a number of analytical methods (assays) suggest that it may be possible to select for disease resilience within nucleus herds in order to improve the health of commercial pigs.

Why was this study done?

Using traditional breeding approaches to improve pig health is very challenging due to the fact that health traits can be difficult to measure. Genomics offers the opportunity to improve health through breeding and eventually be able to select for animals that are more resilient to disease. Such animals would not be resistant to pathogens, but rather they would be able to recover more effectively from infection and continue to perform at levels close to uninfected pigs.

What was done and what was the outcome?

Identifying genetic variation in the immune response of pigs was the first step in this project. Focusing on PRRS, along with other common pig pathogens, researchers identified several genomic regions that may contribute to variation in the viral load and/or survivability of the fetus when the pregnant female is infected with PRRS. The results provided new evidence about the genetic basis of the fetus' response when challenged with the PRRS virus, and may ultimately lead to alternative strategies to control PRRS.

A 'natural challenge' model was developed by the research team with support from PigGen Canada and other funders and used in this study, where the researchers analyzed samples from high health status pigs that were then challenged by being exposed

to multiple diseases in a test barn. Data from 2000 pigs have been collected so far and researchers are working on characterizing disease resilience traits. The goal is to eventually be able to predict disease resilience using different tools such as SNPs or other biomarkers and assays. This 'natural challenge' will be continuing until 2019.

In addition, several new assays were established to analyze samples from pigs involved in the 'natural challenge' model. These assays include:

- High Immune Response (HIR)
- Disease Resistance Assay for Animals (DRAA)
- Natural antibody (NAb)
- Total immunoglobulin (IgG)

Initial results suggest that the HIR, DRAA and NAB are promising new tools to explore disease resilience. These may eventually lead ways to select for disease resilience within nucleus herds in order to improve the health of commercial pigs. These analyses will also continue until 2019.

Genotypes, which will eventually be used for a Genome Wide Association Study, were used with the first pigs involved in the 'natural challenge' to determine the heritability of various resilience traits. Preliminary results demonstrate there is a moderate heritability for disease resiliency (0.2 to 0.3 heritability).

Collaborators

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Additional project information

Click on the links below for further information on this project
Links were last updated in 2022

R&D Featured Articles—by Geoff Geddes for Swine Innovation Porc

Articles may be found at: <http://www.swineinnovationporc.ca/resources-e-newsletters.php>

- [Health Studies Proceeding at Fever Pitch](#)
- October 2019 (Vol. 4, No. 16.)
- [Research on Pig Health is Irresistible](#)
- May 2019 (Vol.4, No. 3.)

Farmscape Interviews:

- [Genomic Selection Offers Promise for Identifying Disease Resilience](#)
- April 23, 2018
- [Genomics Offers Potential to Identify Disease Resilient Livestock](#)
- April 10, 2018
- [Genomics of Particular Value in Selection for Difficult to Measure Traits](#)
- February 3, 2016
- [Selection for Health Offers Almost Perfect Application of Genomic Technology](#)
- January 20, 2016
- [Researchers Explore Genomics to Identify Pigs Resilient to Combinations of Diseases](#)
- October 8, 2015
- [Researchers Look to Harness Genomics to Select for Disease Resilience](#)
- September 23, 2015
- [Genomic Selection Offers Potential for Improved Disease Resistance](#)
- December 9, 2014

Peer-reviewed articles and abstracts:

2017

- Harding, J.C.S., Ladinig, A., Novakovic, P., Detmer, S.E., Wilkinson, J.M., Yang, T., Lunney, J.K., Plastow, G.S. (2017) [Novel insights into host responses and reproductive pathophysiology of porcine reproductive and respiratory syndrome caused by PRRSV-2](#). Abstract. *Veterinary Microbiology* 209: pp. 114-123.
DOI: <https://doi.org/10.1016/j.vetmic.2017.02.019>

2017

- Dekkers, J., Rowland, R.R.R., Lunney, J.K., Plastow, G. (2017) [Host genetics of response to porcine reproductive and respiratory syndrome in nursery pigs](#). Abstract. *Veterinary Microbiology* 209: pp. 107-113.
DOI: <https://doi.org/10.1016/j.vetmic.2017.03.026>



- Harding, J., Ladinig, A., Novakovic, P., Detmer, S., Wilkinson, J., Yang, T., Lunney, J., Plastow, G. (2017) [Novel insights into host responses and reproductive pathophysiology of porcine reproductive and respiratory syndrome caused by PRRSV-2](#). Abstract. *Veterinary Microbiology* 209: pp. 114-123.
DOI: <https://doi.org/10.1016/j.vetmic.2017.02.019>
2016
- Serão, N., Kemp, R., Mote, B., Harding, J., Willson, P., Bishop, S., Plastow, G., Dekkers, J. (2016) [Genetic and Genomic basis of antibody response to porcine reproductive and respiratory syndrome \(PRRS\) in gilts and sows](#). Article. *Genetics Selection Evolution*, 48:51.
DOI: <https://doi.org/10.1186/s12711-016-0230-0>
- Wilkinson, J., Ladinig, A., Bao, H., Kommadath, A., Stothard, P., Lunney, J., Harding, J., Plastow, G. (2016) [Differences in Whole Blood Gene Expression Associated With Infection Time-course and Extent of Fetal Mortality in a Reproductive Model of type 2 Porcine Reproductive and Respiratory Syndrome Virus \(PRRSV\) Infection](#). Article. *PLoS ONE*, 11(4):e0153615.
DOI: <https://doi.org/10.1371/journal.pone.0153615>
- Yang, T., Wilkinson, J., Wang, Z., Ladinig, A., Harding, J., Plastow, G. (2016) [A genome-wide association study of fetal response to type 2 porcine reproductive and respiratory syndrome virus challenge](#). *Scientific Reports*, 6:20305.
DOI: <https://doi.org/10.1038/srep20305>

Additional reading:

2017

- Plastow, G. (2017) [Resilience and PRRS in a natural disease challenge model](#). Abstract. *2017 JOINT MEETING: North American PRRS Symposium: Focusing on PRRS, Emerging and Foreign Animal Diseases and National Swine Improvement Federation*. Chicago, December 2017: p. 41.
Retrieved from: <https://www.vet.k-state.edu/na-prrs/proceedings/index.html>

2017

- Putz, A., Harding, J., Dyck, M., PigGen Canada, Fortin, F., Plastow, G., Dekkers, J. (2017) [Quantifying Resilience Utilizing Feed Intake Data in A Natural Challenge Model For Disease Resilience in Wean-to-Finish Pigs](#). *2017 JOINT MEETING: North American PRRS Symposium: Focusing on PRRS, Emerging and Foreign Animal Diseases and National Swine Improvement Federation*. Chicago, December 2017: p. 107
Retrieved from: <https://www.vet.k-state.edu/na-prrs/proceedings/index.html>
- Putz, A., Harding, J., Dyck, M., PigGen Canada, Fortin, F., Plastow, G., Dekkers, J. (2017) [Novel resilience phenotypes from a natural disease challenge model in wean-to-finish pigs](#). Poster. *Hendrix Genetics Academy 2017, 16-18 Oct, 2017, Montreal, QC*.
- Ferring, C.L., Mote, B.E., Willson, P., Harding, J., Plastow, G., Dekkers, J., Serão, N.V.L. (2017) [Genetic Analysis of Reproductive Traits in Commercial Sows in Health Challenged Herds](#). Abstract for Poster session. *2017 JOINT MEETING: North American PRRS Symposium: Focusing on PRRS, Emerging and Foreign Animal Diseases and National Swine Improvement Federation*. Chicago, December 2017: p. 108
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- Geddes, G. (2017, January 2) [For genomic researchers, success is in the blood](#). Blog post. Retrieved from: <http://genomealberta.ca/livestock/for-genomic-researchers-success-is-in-the-blood.aspx>
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- Putz, A., Harding, J., Fortin, F., Plastow, G., Dekkers, J. (2017) [A natural challenge model for disease resilience in wean-to-finish pigs](#). Abstract. *Journal of Animal Science, 95 (Suppl. 2): p. 17*. DOI: <https://doi.org/10.2527/asasmw.2017.036>

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- Dyck, M., Harding, J., Kemp, B., Willing, B., Goddard, E., Plastow, G. (2016) [Genomics and Swine Health: The Next Steps](#). Article. *Advances in Pork Production: 2016 Banff Pork Seminar Proceedings, Vol. 27: pp. 183-193*. Retrieved from: <https://www.banffpork.ca/proceedings/search>

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- Harding, J., Ladinig, A., Novakovic, P., Detmer, S., Wilkinson, J., Yang, T., Lunney, J., Plastow, G. (2016) [PRRSV and the Pregnant Female](#). Article. *Advances in Pork Production: 2016 Banff Pork Seminar Proceedings, Vol. 27: pp. 169-180*. Retrieved from: <https://www.banffpork.ca/proceedings/search>
- Plastow, G. (2016) [Genomics and Swine Health](#). Article. *Advances in Pork Production: 2016 Banff Pork Seminar Proceedings, Vol. 27: pp. 125-134*. Retrieved from: <https://www.banffpork.ca/proceedings/search>
- Plastow, G. (2016) [Selection for disease resistance in swine](#). Abstract. *Journal of Animal Science, 94 (Suppl. 5): pp. 237-238*. DOI: <https://doi.org/10.2527/jam2016-0494>
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2015

- Plastow, G. (2015) [Solving health problems with genetics](#). Article. *Proceedings of the 2015 London Swine Conference: Production Technologies to Meet Market Demands, April 1-2, 2015, pp. 84-89*. Retrieved from: <https://www.londonswineconference.ca/resources>



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- Serão, N., Kemp, R., Mote, B., Harding, J., Willson, P., Bishop, S., Plastow, G., Dekkers, J. (2014) [Whole-Genome Scan and Validation of Regions Previously Associated with PRRS Antibody Response and Growth Rate using Gilts Under Health Challenge in Commercial Settings](#). Abstract from proceedings. *10th World Congress of Genetics Applied to Livestock Production, Vancouver, BC, August 17-22, 2014*.

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Financial support for this project

This project is part of the Swine Cluster 2 (2013-2018) research program, made possible through financial support from Agriculture and Agri-Food Canada, eight provincial pork producer organizations and over 30 industry partners. [Click here to learn more about the financial partners for Swine Cluster 2](#)

