

Novel Resilience Phenotypes from a Natural Disease Challenge Model for Wean-to-Finish Pigs

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Summary and Implications

Novel phenotypes from a commercial testing system could add value to selection for resilience to disease and other stressors beyond simply collecting mortality. Day-to-day variability in feed intake (FI) and in duration at the feeder (DUR), quantified by root mean squared errors (RMSE), were investigated as novel measures of resilience using data from grow-finish pigs in a natural disease challenge facility.

- RMSE of FI and DUR were moderately heritable
- RMSE of FI and DUR showed moderate to strong genetic correlations with mortality and treatments

These results show that day-to-day variation in FI and DUR in a challenge environment can be used as indicator traits to select for disease resilience.

Introduction

Commercial testing using the final terminal cross is becoming more popular in the swine breeding industry. Typically, mortality is the main phenotype collected in commercial testing farms. However, mortality and treatment data are biased by human intervention. Feed intake data could be used to derive measures of disease resilience because of the physiological effects of disease on appetite. Most individual feed intake recording systems, however, operate in high-health facilities and are expensive to implement in commercial facilities. As an alternative, feeding behavior traits could be recorded in a commercial setting. The purpose of this study was to develop and evaluate measures of resilience based on feed intake and feed intake behavior data.

Materials and Methods

Data: A total of 1341 high-health, weaned F₁ (Large White x Landrace) barrows in 21 single-source batches entered the natural disease challenge facility at the Centre de développement du porc du Québec, Inc. (CDPQ). This challenge included bacterial and viral pathogens including but not limited to PRRS, PCV2, APP, M. hyo, Strep, SIV A. Three phases existed for these trial: i) early nursery for ~ 3

weeks to mimic a clean nucleus environment for collection of early resilience predictors, ii) late nursery for ~ 4 weeks when pigs were first exposed to pathogens, and iii) finishing phase until slaughter with exposure to pathogens. This was a continuous flow system to maintain pathogen challenge across batches. Individual feed intake (FI) was recorded in the finishing phase, which was aggregated to daily FI.

Traditional resilience phenotypes included mortality (0/1) and treatments. Treatments were converted to a rate per 180 days to standardize to the average length to slaughter (# of treatments / age of death * 180; TRT180). Other phenotypes included nursery ADG (NurADG), finishing ADG (FinADG), average daily feed intake (ADFI), feed conversion ratio (FCR), residual feed intake (RFI), carcass weight (CWT), dressing percent (DRS), lean yield (LYLD), carcass backfat (CBF), and carcass loin depth (CLD).

Novel resilience phenotypes: The root mean square error (RMSE) for FI and DUR was computed for each pig by calculating the within animal RMSE from the linear regression of feed intake or duration on age (RMSE_{FI} and RMSE_{DUR}, respectively). Animals with large average deviations from this regression were expected to be less resilient than pigs whose daily data stayed close to the regression line.

Results and Discussion

RMSE_{FI} and RMSE_{DUR} were moderately heritable (0.21 and 0.26, respectively, Table 1) and genetically correlated at 0.47. RMSE measures were genetically correlated with mortality and treatments between 0.40 and 0.62. Overall, RMSE tended to be favorably associated with production phenotypes, but genetic correlations tended to be fairly low in absolute value or uncorrelated.

Table 1. Variance components associated with novel resilience and production traits

Trait	h^2 (SE)	r_g RMSE _{FI}	r_g RMSE _{DUR}
RMSE _{FI} , kg	0.21 (0.07)	-	0.47 (0.26)
RMSE _{DUR} , min	0.26 (0.07)	sym	-
Mortality	0.15 (0.05)	0.37 (0.34)	0.60 (0.26)
TRT180	0.29 (0.07)	0.54 (0.18)	0.63 (0.13)
NurADG, kg/day	0.45 (0.07)	0.77 (0.24)	-0.10 (0.19)
FinADG, kg/day	0.25 (0.07)	-0.31 (0.26)	-0.19 (0.26)
ADFI, kg/day	0.32 (0.07)	0.03 (0.26)	-0.24 (0.21)
FCR, feed/gain	0.35 (0.07)	0.39 (0.21)	-0.17 (0.25)
RFI, kg	0.46 (0.07)	0.35 (0.21)	-0.05 (0.22)
CWT, kg	0.31 (0.08)	-0.04 (0.28)	-0.13 (0.24)
DRS	0.10 (0.06)	-0.23 (0.07)	-0.49 (0.49)
LYLD, %	0.50 (0.08)	0.13 (0.24)	0.00 (0.23)
CBF, mm	0.46 (0.09)	-0.14 (0.26)	0.03 (0.23)
CLD, mm	0.39 (0.08)	-0.20 (0.27)	-0.05 (0.24)

In conclusion, FI and duration data can be utilized to extract novel phenotypes for resilience. Duration is a promising alternative to FI for commercial testing systems that typically do not allow barns with FI systems to break with disease. Not only could these phenotypes help with disease resilience, but also resilience to other stressors such as heat stress.

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