Phenotypic and Genetic Associations of Objectively Evaluated Replacement Female Feet and Leg Joint Conformation at Selection and Post First Parity

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Summary and Implications

Objective evaluation of feet and leg joint conformation is a needed step to improve the repeatability of selection of animals based on proper structure. Objective measurements were taken at the time of selection and during second gestation. Phenotypic and genetic parameter estimates were obtained to better understand the relationship between the measures obtained from objective evaluation. Heritability estimates were low to moderate for all traits measured. Genetic correlations between and within traits at the same time point and between time points were all either small or not different than zero. Low to moderate heritability estimates indicate the ability for these traits to be selected upon effectively. Likewise, low genetic correlations indicate that traits may be selected independent of one another. Therefore, each joint in the objective evaluation can carry its own weight, which will require further investigation beyond the scope of this article.

Introduction

Several individual conformation traits, such as pasterns, knees and hock position, are associated with longevity and survivability in sows. Ideal angles of the objective traits have not been identified, however, the ability to effectively select upon those traits has previously been proven using subjective evaluation. Objectively measured trait parameters must also be investigated to prove that selection is effective using those measures. The objective of this study was to obtain phenotypic and genetic variance components for feet and leg conformation traits from replacement gilts collected at selection and post first parity.

Materials and Methods

In total, 319 maternal gilts (range 19 to 25 weeks) were video recorded. Of those 319, 277 were again video recorded during their 2nd gestation (range 0 to 87 days). Images were extracted from video using computer software (AVcutty v3.5, Andreas von Damaros, Krefeld, Germany, www.avcutty.de). Joint angles for the knee, front and rear pastern, hock, and rear stance were measured using the angle feature in image analysis software ImageJ (ImageJ, National Institute of Health, Bethesda, MD). Variance components for each joint were estimated using single (heritability) and 2-trait (genetic correlation) animal models with AIREMLF90. Heritability estimates were calculated as additive genetic variance divided by total variance.

Results and Discussion

Heritability, phenotypic and genetic correlation estimates for the joint conformation traits at time of selection and post first parity are displayed in Tables 1 and 2 respectively. Heritability estimates were low to moderate for all traits measured and ranged from 0.00 to 0.40. Heritability estimates were lower when measured at selection compared to heritability estimates post first parity in the knee, rear pastern and hock by 0.14, 0.04 and 0.11, respectively. Heritability estimates were greater at selection when compared to heritability estimates collected post first parity in the front pastern and rear stance position, with a difference of 0.10 and 0.14, respectively. Phenotypic correlation estimates between the joints and for joint angle difference at selection and post first parity were all small. Genetic correlation estimates were small and most standard errors were greater than their estimates. Objectively measured feet and leg conformation traits share similar heritability estimates to those obtained when traits are measured subjectively. These low to moderate estimates indicate the ability for these objective traits to be selected upon. Further, due to low genetic correlations across the specific traits, selection for one will have little impact on selection of another, so independent selection on each trait is feasible. Once optimal values are obtained for extended longevity, the ability to select animals based on those criteria could yield greater results than subjective systems due to the increase in repeatability from objective evaluation.

Table 1. Linear model heritability estimates (±SE; diagonal), genetic (±SE; above diagonal) and phenotypic (below diagonal) correlation estimates for objectively measured feet and leg angles in 319 gilts at selection.

Traits	Knee	Front Pastern	Rear Pastern	Hock	Rear Stance
Knee	**0.26** ± 0.06	-0.25 ± 0.19	0.19 ± 0.19	-0.15 ± 0.23	NA[1]
Front Pastern	0.00	**0.30** ± 0.06	0.17 ± 0.06	0.14 ± 0.21	NA
Rear Pastern	0.08	0.30	**0.23** ± 0.06	-0.27 ± 0.24	NA
Hock	0.16	0.14	0.03	**0.16** ± 0.06	NA
Rear Stance	-0.04	0.07	0.15	-0.12	**0.30** ± 0.20

[1]NA = not applicable; model did not converge

Table 2. Linear model heritability estimates (±SE; diagonal), genetic (±SE; above diagonal) and phenotypic (below diagonal) correlation estimates for objectively measured feet and leg angles in 277 sows post first parity.

Traits	Knee	Front Pastern	Rear Pastern	Hock	Rear Stance
Knee	**0.40** ± 0.06	0.10 ± 0.20	-0.01 ± 0.16	0.16 ± 0.16	NA[1]
Front Pastern	0.21	**0.20** ± 0.06	0.22 ± 0.21	0.12 ± 0.22	NA
Rear Pastern	0.02	0.16	**0.27** ± 0.06	0.11 ± 0.18	NA
Hock	0.03	0.15	0.10	**0.27** ± 0.06	NA
Rear Stance	0.00	0.10	0.13	-0.02	**0.16** ± 0.14

[1]NA = not applicable; model did not converge