Abstract M73

Genetic Parameters of Characteristics of Lifetime Pre-weaning Production Traits of Landrace Sows Raised under Tropical Conditions

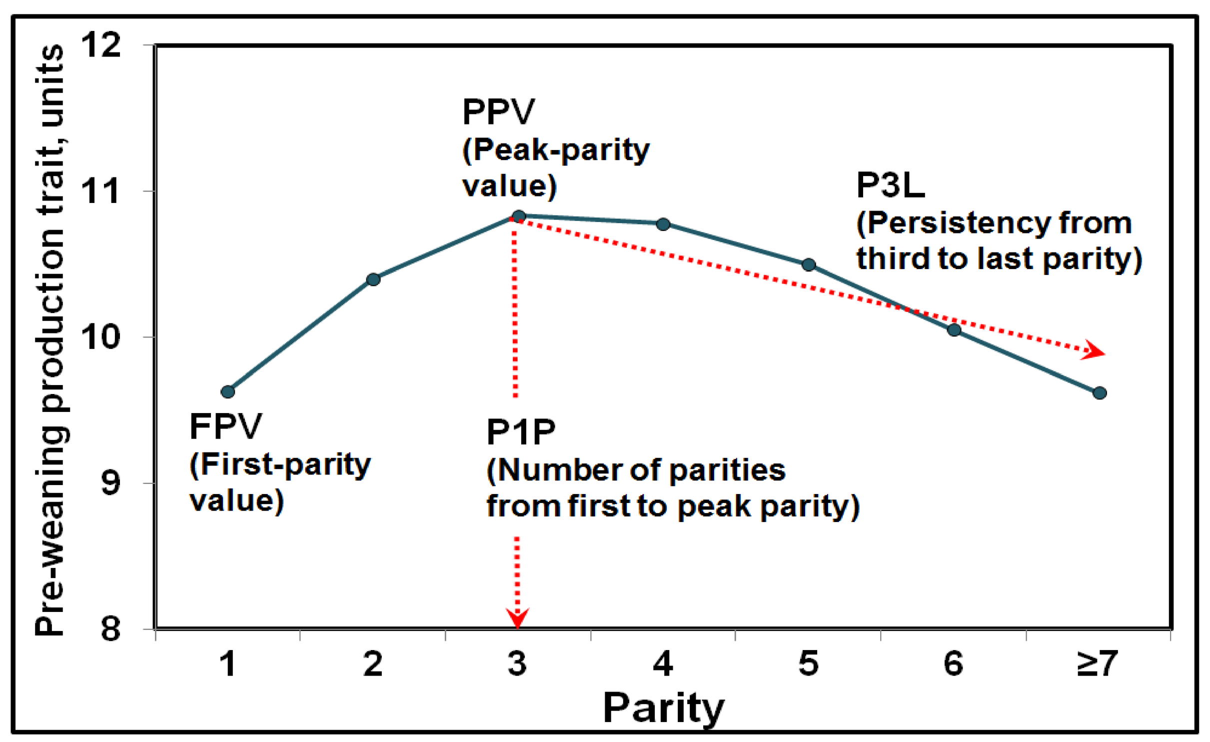
Teerapong Jaichansukkit*, Thanathip Suwanasopee*, Skorn Koonawootrittriron* and Mauricio A. Elzo†

*Department of Animal Science, Kasetsart University, Bangkok 10900, Thailand

†Department of Animal Sciences, University of Florida, Gainesville, FL 32611-0910, USA

SUMMARY

Lifetime pre-weaning production traits are important for increasing profitability in commercial swine operations. Sows with larger pre-weaning production from the first to the last parity in her lifetime are preferred. Thus, it is important to determine how heritable lifetime pre-weaning production traits are in swine populations under tropical conditions in Thailand. Consequently, the objective of this study was to estimate genetic parameters for characteristics of lifetime pre-weaning production traits of Landrace (L) sows raised in an open-house system in Thailand. The pre-weaning production traits were number of piglet born alive (**NBA**), number of piglets weaned (**NPW**), average weight of piglets at birth (**ABW**), and average weight of piglets at weaning (**AWW**). The characteristics considered for these traits were first-parity value (**FPV**), peak-parity value (**PPV**), number of parities from first-parity to peak-parity (**P1P**), and persistency from the third to the last parity (regression coefficient; **P3L**). The dataset contained 6,075 performance records from 941 sows that farrowed from 2004 to 2012. Variance components for each characteristic were estimated separately for the four traits using an AI-REML procedure. The 4-trait animal model for each characteristic included first-farrowing year-season and age at first farrowing as fixed effects, and sow and residual as random effects. Heritability estimates ranged from 0.04 (**NPW**) to 0.10 (**ABW**) for **FPV**, 0.06 (**NPW**) to 0.20 (**NBA**) for **PPV**, 0.01 (**NBA**) to 0.04 (**ABW**) for **P1P**, and 0.03 (**NPW**) to 0.17 (**ABW**) for **P3L**. Genetic correlation estimates ranged from -0.47 (**NPW-AWW**) to 0.87 (**ABW-AWW**) for **FPV**, -0.10 (**NPW-AWW**) to 0.85 (**ABW-AWW**) for **PPV**, -0.73 (**NBA-NPW**) to 0.58 (**NBA-AWW**) for **P1P**, and -0.70 (**NPW-AWW**) to 0.13 (**NPW-ABW**) for **P3L**. Low heritability estimates for all characteristics in these four lifetime pre-weaning production traits indicated that genetic improvement for these characteristics in all these traits would either be slow or nonexistent in this Landrace population.



INTRODUCTION

Lifetime pre-weaning production (**PWP**) traits in sows could increase profitability in commercial swine operations. The **PWP** traits include number of piglet born alive (**NBA**), number of piglet weaned (**NPW**), average weight of piglet at birth (**ABW**), and average weight of piglets at weaning (**AWW**). High values for these traits are important for purebred Landrace (**L**) sows as dam lines in crossbreeding mating programs. In general, sows tend to increase their **PWP** traits values from the first-parity to the peak-parity and then decrease in later parities (Hoving et al., 2011). These **PWP** trends across parities can be characterized into first-parity value (**FPV**), peak-parity value (**PPV**), number of parities from first-parity to peak-parity (**P1P**), and persistency from the third to the last parity (regression coefficient; **P3L**). Large values for all these characteristics are preferred by producers. Thus, utilization of these four characteristics for each **PWP** trait as phenotypes for genetic evaluation and selection are necessary to improve Landrace maternal lines to increase the profitability of crossbred swine operations. Therefore, the objective of this study was to estimate genetic parameters for characteristics of lifetime pre-weaning production traits of Landrace sows raised in an open-house system under tropical conditions in Thailand.

MATERIALS AND METHODS

Data, Animals and Traits: The dataset was from a commercial swine farm located in Northern Thailand. There were 6,075 phenotypic records from 941 purebred Landrace sows that farrowed between 2004 and 2013. Records included identity number, birth date, farrowing date, parity number and their lifetime pre-weaning production (**PWP**) traits. The **PWP** traits were lifetime of number of piglets born alive (**NBA**), number of piglets weaned (**NPW**), average piglet birth weight (**ABW**), and average piglet weaning weight (**AWW**). The four characteristics defined for each **PWP** trait were first-parity value (**FPV**), peak-parity value (**PPV**), number of parities from the first parity to the peak parity (**P1P**), and persistency from the third to the last parity (regression coefficient; **P3L**).

Climate, Nutrition and Management: Season was classified as winter (November to February; 17°C to 30°C, 69%RH), summer (March to June; 21°C to 35°C, 66%RH), and rainy (July to October; 23°C to 31°C, 80%RH). All gilts and sows were kept in an open-house system. Barn temperature was controlled with fans equipped with steamers for gilts and non-lactating sows, and with water dippers for nursing sows. Breeding sows were fed 2.5 kg of a 16% protein ration per day (3,200 to 3,500 kcal/kg). Nursing sows were fed 6 kg of an 18% protein ration per day (4,060 kcal/kg). Replacement gilts were selected based on growth and reproductive records. Estrus detection of gilts and sows was done twice a day. Sows were artificially inseminated 12 hours after detection of estrus and again 12 hours later. The first insemination of replacement gilts occurred at 8 to 9 mo of age or 140 kg of body weight. Pregnant gilts and sows were moved to individual farrowing pens approximately one week before the expected parturition. All gilts and sows gave birth without assistance. Piglets were weaned at approximately 25 days after parturition.

Statistical analysis: Four-trait animal models were used to estimate variance components for each characteristic (**FPV**, **PPV**, **P1P**, and **P3L**) of the four traits (**NBA**, **NPW**, **ABW**, and **AWW**) using restricted maximum likelihood procedures with an average information algorithm (AI-REML). The four-trait model for each characteristic included contemporary group (defined as year-season at first farrowing) and age at first farrowing as fixed effects, and sow and residual as random effects. Variance components were used to calculate heritabilities and genetic and phenotypic correlations for the characteristics of all traits.

RESULTS AND DISCUSSION

Fixed Effects: Year-season at first farrowing influenced all characteristics from all **PWP** traits (P < 0.05), except for **P3L** for **NBA**, **ABW** and **AWW**. Age at first farrowing only affected **FPV** for **NPW** (P = 0.039) and **ABW** (P = 0.038), and **P1P** for **NPW** (P = 0.007). The regression coefficients of **FPV** on age at first farrowing for **NPW** and **ABW** were positive, but the regression coefficient of **P1P** on age at first farrowing for **NPW** was negative. This indicated that first-parity older sows had higher **NPW** (P = 0.039) and **ABW** (P = 0.038), and lower numbers of parities to peak (P = 0.007) than younger first-parity sows. First-parity sows need more intensive supervision and management from the stockman to produce large number of piglets with heavy weights at weaning than older sows (Kraeling and Webel, 2015).

Table 1 Estimated variance components and heritability for characteristics of lifetime pre-weaning production traits

Characteristic	Trait	V_a	V_e	$h^2 \pm SE$
FPV	NBA	1.09	10.42	0.10 ± 0.01
	NPW	0.31	7.39	0.04 ± 0.01
	ABW	0.01	0.09	0.10 ± 0.01
	AWW	0.06	1.11	0.05 ± 0.01
PPV	NBA	0.72	2.97	0.20 ± 0.01
	NPW	0.07	1.06	0.06 ± 0.01
	ABW	0.01	0.05	0.14 ± 0.01
	AWW	0.13	1.04	0.11 ± 0.01
P1P	NBA	0.01	2.60	0.01 ± 0.01
	NPW	0.04	2.23	0.02 ± 0.01
	ABW	0.11	2.98	0.04 ± 0.01
	AWW	0.08	3.07	0.03 ± 0.01
P3L	NBA	0.13	2.33	0.05 ± 0.01
	NPW	0.05	1.37	0.03 ± 0.01
	ABW	0.01	0.02	0.17 ± 0.01
	AWW	0.02	0.46	0.04 ± 0.01

Variance components: Estimates of genetic and residual variances for each characteristic of all **PWP** traits are shown in **Table 1**. The additive genetic and phenotypic variances for **FPV** and **PPV** from all **PWP** traits were different because animals generally expressed these phenotypes in different periods of life (Skorput et al., 2014). Additionally, missing phenotypic and pedigree information due to culling for low litter size and reproductive problems in later parities may have also affected the estimation of the variability of these characteristics (Hanenberg et al., 2001).

Genetic parameters: Heritability estimates ranged from 0.04 (**NPW**) to 0.10 (**ABW**) for **FPV**, 0.06 (**NPW**) to 0.20 (**NBA**) for **PPV**, 0.01 (**NBA**) to 0.04 (**ABW**) for **P1P**, and 0.03 (**NPW**) to 0.17 (**ABW**) for **P3L** (Table 1). These heritability values indicate that selection for most characteristics of **PWP** traits would likely show slow genetic progress. However, genetic selection for **PPV** within **NBA**, **PPV** and **P3L** within **ABW** should result in faster genetic progress. Regardless of the trait, a more intensive management system would need to accompany genetic selection to increase sow phenotypic lifetime productivity.

Genetic and phenotypic correlations are presented in **Table 2**. Estimates of genetic correlations for all characteristics of **PWP** traits were low, except for **FPV** of **NBA-NPW** (r_g = 0.77) and **ABW-AWW** (r_g = 0.87), and **PPV** of **ABW-AWW** (r_g = 0.85) among *positive* genetic correlations, and **P1P** of **NBA-NPW** (r_g = -0.73), and **P3L** of **NPW-AWW** (r_g = -0.70) among *negative* genetic correlations. An increase in **NBA** and **ABW** in the first-parity, and **ABW** in the peak-parity would increase **NPW** and **AWW**. Additionally, sows with strong persistency for **NPW** would have weak persistency for **AWW**. Phenotypic correlation estimates were low and ranged from 0.01 to 0.34 for all characteristics of all **PWP** traits.

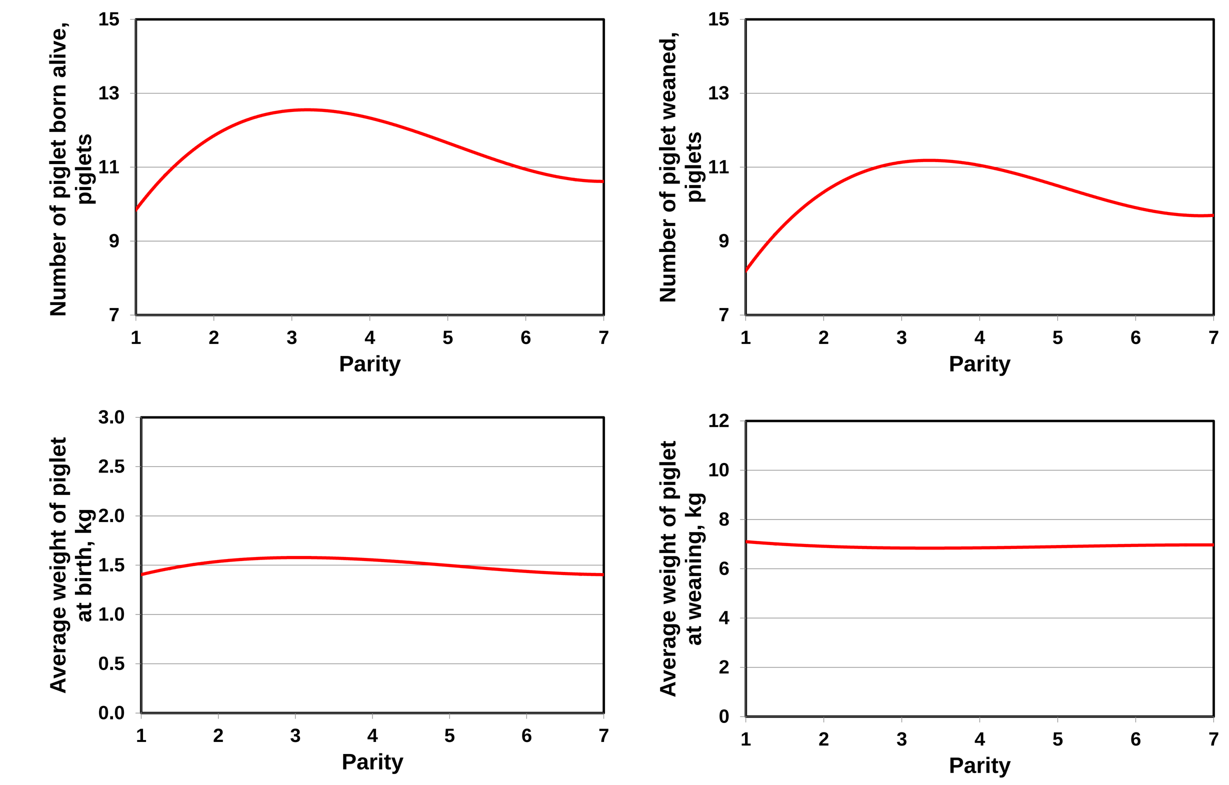


Table 2 Genetic correlations (above diagonal) and phenotypic correlations (below diagonal) for characteristics of lifetime pre-weaning production traits

Characteristic	Trait	NBA	NPW	ABW	AWW
FPV	NBA		0.77	-0.26	-0.02
	NPW	0.34		-0.42	-0.47
	ABW	0.09	0.16		0.87
	AWW	-0.15	0.03	0.19	
PPV	NBA		0.34	-0.04	0.28
	NPW	0.21		0.18	-0.10
	ABW	-0.13	0.08		0.85
	AWW	-0.01	-0.01	0.26	
P1P	NBA		-0.73	0.32	0.58
	NPW	0.25		0.01	0.02
	ABW	0.01	0.13		0.00
	AWW	-0.00	-0.01	0.24	
P3L	NBA		-0.24	0.05	-0.49
	NPW	0.19		0.13	-0.70
	ABW	0.06	0.13		0.02
	AWW	-0.18	-0.13	0.14	

FINAL REMARKS

- *Heritabilities for four characteristics of lifetime pre-weaning production traits were low*
- *Genetic improvement in this population for all characteristics in all traits is expected to be slow or nonexistent*
- *Management improvement should accompany genetic selection for characteristics of all traits to increase sow phenotypic lifetime productivity*

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