GENETIC PARAMETERS AND GENETIC TRENDS FOR LITTER SIZE AND SURVIVAL AT BIRTH IN LANDRACE PIGLETS

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SUMMARY

Estimates of co variances and genetic parameters, and quantification of the genetic and phenotypic trend from a population of Landrace pigs was conducted in Venezuela. A total of 4 520 records of animals born between 1991 and 2000 in two commercial pig farms were evaluated. For both traits, piglet survival and litter size at birth, the selected model included farm (2), year (10) and month (12) of birth and age of dam (7) as fixed effects and animal and maternal genetic as a random effects.

Average litter size was 9.81 and the estimate of direct heritability was 0.13 ± 0.02. The correlation between direct genetic and maternal genetic effects was (0.68 ± 0.21), for litter size, therefore, selection on direct genetic effects could improve maternal response also. The correlation between direct genetic and maternal genetic effects was (0.68 ± 0.21), for litter size, therefore, selection on direct genetic effects could improve maternal response also. The estimate of maternal heritability was close to cero (0.03 ± 0.02). Estimates of direct and maternal heritability for piglet survival were close to zero, 0.02 ± 0.01 and 0.02 ± 0.01, respectively. The genetic correlation between direct and maternal effects was 0.65 ± 0.67, however, this value was not significant (P<0.25). The estimate of the genetic correlation between litter size and piglet survival was positive but low (0.24 ± 0.26). The annual genetic trend for litter size was low (0.03; P<0.05) and quite linear, therefore implying an increase of 0.03 piglet/year. The annual environmental trend for litter size was irregular and low and the mean was 0.09 (P<0.01). The annual genetic and phenotypic trends for survival at born were close to zero and non-significant (0.03 and 0.5, respectively).

The results showed that selection for litter size in Landrace pigs could be effective but relative slow due to low estimate of heritability, while for piglet survival, environmental would play a key role. Selection on direct litter size EPD would have a positive effect on maternal effects. Selection on litter size would have a positive impact on survival at born; however, more research is needed in this area.

Key words: *pigs, litter size, survival at born, Landrace*

Short title: *Genetic parameters and trends in Landrace piglets*

PARÁMETROS GENÉTICOS Y TENDENCIAS GENÉTICAS PARA TAMAÑO DE CAMADA Y SUPERVIVENCIA AL NACIMIENTO DE CERDITOS LANDRACE

RESUMEN

Se llevó a cabo un estudio sobre las estimaciones de la covarianza y parámetros genéticos, y la cuantificación de la evolución genética y fenotípica de una población de cerdos Landrace, en Venezuela. Se evaluaron un total de 4 520 registros de los animales nacidos entre 1991 y 2000 en dos granjas comerciales de cerdos. Para ambos rasgos, supervivencia de los lechones y tamaño de la camada al nacer, el modelo seleccionado incluyó la granja (2), año (10) y el mes (12) de nacimiento y edad de la madre (7) como efectos fijos y de los animales y la genética materna como efectos al azar.

La media para el tamaño de la camada fue 9.81 y la estimación de heredabilidad directa fue de 0.13 ± 0.02. La correlación entre los efectos genéticos directos y la genética materna fue de (0.68 ± 0.21), para el tamaño de la camada, por lo que se evidenció que la selección directa de los efectos genéticos pueden mejorar la respuesta de la madre también. La estimación de la heredabilidad materna fue aproximadamente cero (0.03 ± 0.02). Las estimaciones de heredabilidad directa y materna para la supervivencia de los lechones fueron cercanas a cero, 0.02 ± 0.01 y 0.02 ± 0.01, respectivamente. La correlación genética entre los efectos directos y maternos fue de 0.65 ± 0.67, sin embargo, este valor no fue significativo (P<0.25). La estimación de la correlación genética entre el tamaño de la camada y la supervivencia de los lechones fue positiva, pero baja (0.24 ± 0.26). La tendencia genética anual del tamaño de la camada fue baja (0.03, P <0.05) y bastante lineal, por lo tanto esto implica un aumento de 0.03 lechones /año. La tendencia anual sobre medio ambiente para el tamaño de la camada era irregular y baja y la media fue de 0.09 (P <0.01). Las tendencias genéticas y fenotípicas anual para supervivencia al nacimiento fueron cercanas a cero y no significativas (0.03 y 0.5, respectivamente).

Los resultados muestran que la selección para el tamaño de la camada en Landrace puede ser eficaz pero relativamente lenta debido a la baja estimación de la heredabilidad, mientras que para la supervivencia de los lechones, el medio ambiente desempeña un papel *clave. La selección del tamaño de la camada directa podría tener un efecto positivo sobre los efectos maternos. La selección del tamaño de la camada podría tener un impacto positivo en la supervivencia al nacimiento, sin embargo, se necesita profundizar más en las investigaciones en esta área.*

Palabras claves: *cerdos, tamaño de camada, supervivencia al nacimiento, Landrace*

Título corto: *Parámetros y tendencias genéticas en cerditos Landrace*

INTRODUCTION

Litter size in pigs production systems is one of the most important economical traits (Fahmy et al 1971; Verde 1994). This trait alone with total litter weight represents the principal components of genetic program in pig production system in Venezuela. In any animal production, survival is very important to be successful. Most of the time production traits are in someway associated. An increase in litter size would raise space and food competition, which would reduce the survival. On the other hand, is well known that survival has a low heritability ranging from 0.1 to 0.2 (Galíndez 2004).

It is important to take in account the genetic parameters when designing genetic programs, where selection plays a key role. Therefore, the objectives of the present study were to estimate (co)variances and genetic parameters, and quantify the genetic and phenotypic trend in Landrace piglets reared in commercial conditions in Venezuela.

MATERIALS AND METHODS

Covariance components for survival (ST) and litter size (LS) at birth (total number piglets born) were analyzed using restricted maximum likelihood (REML) methodology applied to a two-trait animal model using the MTDFREML program (Boldman et al 1995). Data used were 4 530 records of Landrace piglets born years 1991 through 2000. For both traits the model included farm (2), year (10) and month (12) of birth and age of dam (7) as fixed effects and animal and maternal genetic as a random effects. Starting values for the estimates of (co)variance components were obtained from the literature. Iterations were stopped when the variance of the function values (i.e., -2logL with L= likelihood (b,u|y)) of the simplex was less than the convergence criterion (1×10^{-9}). Once the convergence criterion was reached, cold restart were continued until the -2logL differed less than 1×10^{-2} between successive restarts.

Genetic trends were estimated by regressing averages of estimated breeding values by year of birth for each line on birth year. Environmental trend was estimated regressing the solutions for year of birth on birth year. Both farms had similar managements conditions, animals were fed balance food produced in the farm. Piglets were managed according to standard procedures (castration, iron supplementation, tail cut, a vaccination). All females were under artificial insemination.

The basic model was: $y = X_b + Z_a + Z_m + e$

where: y is the Nx1 vector of records, X and Z are the known incidence matrices that associate levels of b, a and m with y, b denotes the unknown vector of fixed effects, a is the unknown vector of breeding values for direct additive genetic effects, m is the unknown vector of breeding values for maternal additive genetic effects, and e is the vector of residual effects.

RESULTS AND DISCUSSION

Average LS was 9.81 and higher than those reported by Chang (1997) and Galíndez (2004). The average ST was 93.78 % and slightly superior than means published by Chang (1997) and Galíndez (2004). These differences could be due that the present research was done with a different breed than that used by Chang (1997) and Galíndez (2004). The phenotypic variances were 8.64 and 128.14 for LS and ST, respectively.

Estimate of direct heritability was 0.13 ± 0.02 for LS (table 1). This estimate was slightly higher than estimates reported by Crump et al (1997), De Venanzi (1998) and Galíndez (2004). The analysis show that LS could respond to a genetic program and some genetic progress can be achieve a through direct selection on LS.

Table 1. Estimates of genetic parameters (s.e.) in the Landrace line [1]

	Trait	Direct genetic effect (A_d)		Maternal genetic effect (A_m)	
		LS	ST	LS	ST
(A_d)	**LS**	**0.13 (0.02)**			
	ST	0.24 (0.26)	**0.02 (0.01)**		
(A_m)	**LS**	0.68 (0.21)	0.33 (0.41)	**0.03 (0.02)**	
	ST	0.23 (0.45)	0.65 (0.67)	0.78 (0.61)	**0.02 (0.02)**

[1] Heritabilities (s.e.) on the diagonal, genetic correlations below the diagonal.

The correlation between direct genetic and maternal genetic effects was (0.68 ± 0.21), for LS, therefore, selection on direct genetic effects could improve maternal response also. This had been reported previously by Crump et al (1997). The estimate of maternal heritability was close to cero (0.03 ± 0.02), and was in agreement with Crump et al (1997). On the other hand, a value of 0.10 was reported by Galíndez (2004). However, this last author analyzed total number of piglets born alive, that could explain the divergence.

Estimates of direct and maternal heritability for ST were close to zero, 0.02 ± 0.01 and 0.02 ± 0.01, respectively (table 1) and similar to values reported on other Latin American herds (Colmenares et al 1994; Galíndez 2004). The genetic correlation between direct and maternal effects was 0.65 ± 0.67, however, this value was not significant (P<0.25). The estimate of the genetic correlation between LS and ST was positive but low (0.24 ± 0.26).

This estimate indicates that selection for larger total litters will increase the survival. This estimate is different in sign and magnitude from the value reported The environmental correlation between LS and ST was -0.20, and suggests that as the environmental conditions are improved in one of the trait it will have a negative impact on other trait.

The annual genetic trend for LS was low (0.03; P<0.05) and quite linear, this implies an increase of 0.03 piglet/year. The annual environmental trend for LS was irregular and low and the mean was 0.09 (P<0.01). The annual genetic and phenotypic trends for ST were close to zero and non-significant (0.03 and 0.5, respectively).

The results show that selection for LS in Landrace pigs could be effective but relative slow due to low estimate of heritability, while for ST environmental would play a key role. Selection on direct litter size EPD would have a positive effect on maternal effects. Selection on LS would have a positive impact on ST; however, more research is needed in this area.

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