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SOURCES OF SPECIFIC VARIANCE AND GENETIC DETERMINATION OF SOW LONGEVITY AND SERVICE PERIOD IN PIGS WITH DIFFERENT ORIGIN

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Abstract

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The purpose of the current study was to estimate variance components and the genetic determination of the sow longevity and the service period in pigs with different origin.

The study comprised 2488 sows originated from 137 sires with the following origin: Danube White, Large White with a polish origin and fattening pigs, classified in three different farms. The study was carried out during the period 1999 - 2008. The first ten parities were analyzed. The furrowing seasons were classified in four categories according to the climate determination of the country.

The variance analysis, the heritability, as well as the genetic correlations were made according to the methodology of the mixed models. The normal data distribution achieved by logarithmic transformation of the scale of measurements was an objective of an analysis.

The phenotypic variation of the sow longevity and the service period were significantly affected by the breed, litter (parity) and year of birth.

Low values of heritability for the studied traits ($h^2 = 0.05$) were specified. Average to high values of calculated genetic correlations ($r_g = 0.6$) was the reason to suppose that the selection according to the born alive would positively affect on the sow longevity.

Key words: sow longevity, service period, genetic determination

Introduction

The sow longevity and the productive life were important traits for obtaining larger production of piglets. Every year, approximately 50% of sows were replaced (Boyle et al., 1998; Rodriguez-Zas et al., 2003; Engblom et al., 2007). The high removal rate of mainly young animals generate ethical and economical problems of great importance. Approximately 15 to 20% of the culled sows have produced only 1 litter, and more than 50% were removed before their fifth parity (Boyle et al., 1998; Lucia et al., 2000; Engblom et al., 2007).

The continuous using of sows reflected greater parity production and lower risk of reproductive disorders and lameness. The quick generation change withdraws a privilege of welfare existence and further reproduction (Serenius and Stalder, 2006).

According (Engblom et al., 2008) the main reasons about sow removals were the later age at first furrowing, low production and the long interval from weaning to next furrowing.

The objective of this study was to determine sources of specific variance and genetic determination of the traits sow longevity and service period in pigs with different origin.

Material and Methods

The study comprised 2488 sows from 137 sires with the following origin: Danube White, Large White from a polish origin and fattening pigs, classified in three different farms. The sows housing during the service period differed by environment and technology – individually for the Danube White and the fattening pigs and in a group for the Large White from a polish origin. The animals were raised within a group during the pregnancy and individually at the furrowing and suckling periods.

The study was carried out during the period 1999 - 2008. From 1 to 10 births were analyzed. The set of data excluded information about more than 10 births because of their low rate. The furrowing seasons were classified in four categories: winter from December to February, spring from March to May, summer from June to August and autumn from September to November.

The traits service period and sow longevity from birth to final furrowing were an objective of the mixed model analysis of variance, heritability and genetic correlations. All calculations were made by the software package LSMLMW&MIXMDL, Pc-2 version, Harvey (1990).

The following statistical model was used:

$$Y_{i-p} = \mu + S_I + B_{J(1-3)} + L_{K(1-10)} + Y_{L(1-10)} + SE_{M(1-4)} + R_{NBA} + e_{i-o}$$

Where: μ - average;

- S_I - random effect of the sire (1-137);
- $B_{J(1-3)}$ - fixed effect of the breed (1-3);
- $L_{K(1-10)}$ - fixed effect of the litter (1-10);
- $Y_{L(1-10)}$ - fixed effect of the year (1-10);
- $SE_{M(1-4)}$ - fixed effect of the furrowing season (1-4);
- R_{NBA} - regression effect of the number of born alive;
- e_{i-o} - residual variance.

The normal distribution of the data was achieved using the logarithmic transformation of the scale of measurements. The differences between the levels of studied factors were established regarding the degree of distribution according to Studant (Hayter, 1984):

$$(y_i - y_j) / \; S \sqrt{(1/n_i + 1/n_j)} /2$$

Where: $(y_i - y_j)$ – differences between the average values from the studied factor levels; S – standard deviation; n_i and n_j – number of the individuals for the corresponding levels.

Results

The average values and coefficients of variation of sow longevity and service period are given in Table 1. The logarithmic transformation of the scale of measurements reduced the variation to 2.17% and 2.65% respectively for both traits. The purpose was to increase the accuracy of analysis, using achieved normal distribution of the data. Mathematically proved regression effect ($P \leq 0.05$) of the number of born alive was established after logarithmic transformation.

The variance analysis and the F- test are given in Table 2. The results determined significant influence of the studied factors ($P \leq 0.001$), except for the season of furrowing. The values of the coefficients of the determination (R = 0.901 and

Table 1

Estimation of service period and sow longevity based on real and transformed phenotypic values

Traits	Sow longevity		Service period	
	Real values	transformed	Real values	transformed
LSM	881	3.038	764	2.98
SE	11.02	0.004	11.13	0.004
SD	422.2	0.19	389.4	0.23
C	22.26	2.17	14.87	2.65
$R_{(hy)}$	1.345±1.770	0.0010±0.0005*	1.230±1.025	0.0014±0.0006*

Level of significance: * - P ≤0.05.

Table 2

ANOVA of the examined traits

Sources of variability	df	Sow longevity F- test	Service period F-test
Breed	2	+++	+++
Litter	9	+++	+++
Year of birth	9	+++	+++
Season of farrowing	3	n.s.	n.s.
R^2 of the model	Real values	0.786	0.901
	Transformed	0.901	0.902

Level of significance: *** - P ≤0.001.

R= 0.902) showed that the factors in the model described precisely the variation of the examined traits.

The longest period of using the sows and the longest service period was established for Danube White, following fattening pigs and Large White. The differences between the separate origins were well proved in P≤0.001 (Table 3). The effect of the number of the litters was shown in the same table. The increase of the number of litters led to the larger values of the examined traits. There was a high reliability of the differences between the separate parities except for those between the last three litters. The smaller number of the sows there may be led to these differences.

The influence of the birth year for the studied traits was with a different level of significance, as in the first four years the pigs were characterized with longer longevity and service period. There was no proof for the differences between the last three years and this probably caused the smaller number of the sows in the extract (Table 4). The differences were not significant regarding the effect of the season of furrowing.

The additive changeability of the sow longevity and service period was with low values ($h^2 = 0.05$). Regarding the number of born alive the heritability was higher: ($h^2 = 0.27$) (Table 5). The phenotypic correlations between the studied traits and the number of born alive were low ($r_p = 0.11$ and $r_p = 0.12$), while the genetic correlations ranged from average to high by value ($r_g = 0.6$). The values of the calculated genetic parameters imply that selection concerning the born alive would affect positively the longevity of sows. On the other hand higher number of born alive piglet (as one of the

Table 3

Effects of the breeds and the litter series upon the service period and the sow longevity

Factors	Levels	Number	LSC	SE	Significance of the differences	LSC	SE	Significance of the differences
		Longevity				Service period		
Transformed LSM		2488	3.038	0.004		2.98	0.004	
Geno-types	Danube White	1238	0.026	0.001	1 - 2.3***	0.032	0.002	1 - 2.3***
	crossbreeds	601	-0.002	0.002	2 - 3***	-0.002	0.003	2 – 3***
	Large White	649	-0.23	0.002		-0.031	0.002	
Litter series	First litter	527	-0.41	0.003	1 - 2.3.4.5.6.7.8.9.10***	-0.492	0.005	1- 2.3.4.5.6.7.8.9.10***
	II litter	521	-0.25	0.003	2 - 3.4.5.6.7.8.9.10***	-0.283	0.005	2 - 3.4.5.6.7.8.9.10***
	III litter	394	-0.14	0.004	3 – 4.5.6.7.8.9.10***	-0.152	0.005	3 – 4.5.6.7.8.9.10***
	IV litter	332	-0.05	0.004	4 – 5.6.7.8.9.10***	-0.056	0.005	4 – 5.6.7.8.9.10***
	V litter	260	0.016	0.005	5 – 6.7.8.9.10***	0.025	0.005	5 – 6.7.8.9.10***
	VI litter	205	0.072	0.005	6 – 7.8.9.10***	0.087	0.006	6 – 7.8.9.10***
	VII litter	138	0.122	0.006	7 – 8.10*	0.143	0.007	7 – 10*
	VIII litter	74	0.168	0.007	7 – 9***	0.194	0.009	7 – 8.9***
	IX litter	30	0.214	0.011		0.244	0.013	
	X litter	7	0.259	0.021		0.292	0.257	

Levels of significance * (P≤0.05), **(P≤0.01), ***(P≤0.001).

possible reasons) would guarantee the service for the next furrowing.

Discussion

Engblom et al. (2008) investigated the factors that might influence the length of productive life in Swedish fattening pigs. They established that sow longevity was determined by many factors. Not only the sow's biology, but also season, management, and housing were important. In addition, the herdsman's subjective decisions for the sow culling were possible. Results in their study showed significant influence of the interaction herd * year and the fertility of sow longevity (P≤0.001). They pointed also at the lack of influence of the month of furrowing and the greatest number of sow culling from July to August.

Serenius et al. (2006) have studied six different genetic lines. They found out that the differences in sow longevity from the different genetic lines were genetically determinate.

In another research Serenius and Stalder (2006) indicated the heritability depended on sow longevity trait's definition (continuous or binary), genetic differences between studied populations and used methods of analysis.

Estimated length of productive life heritability values obtained from linear model analyses indicated similar results (h^2 ranged from 0.02 to 0.11) (Tholen et al., 1996a;b; Lopez – Serrano et al., 2000; Serenius and Stalder, 2004).

The published estimations of the genetic correlations between the litter size and the sow longevity ranged from r_g = -0.25 to r_g = 0.45 (Tholen et al., 1996; Serenius and Stalder, 2004). However, it was indicated that the values of genetic correlations might be influenced by the fact that farmers were not retaining or keeping sows that produced small litters.

Table 4

Effects of birth and season of farrowing upon service period and sow longevity

Factors	Levels	Number	LSC	SE	Significance of the differences	LSC	SE	Significance of the differences
			Longevity			Service period		
Transformed LSM		2488	3.038	0.004		2.981	0.004	
Year of mother's birth	1999	53	0.051	0.008	1 – 4*	0.062	0.010	1 – 4.9*
	2000	237	0.036	0.004	1 – 5.6.7.8.9.10***	0.043	0.005	1 – 10**
	2001	327	0.057	0.004	2 – 3.4.9.10*	0.063	0.005	1 – 5.6.7.8***
	2002	362	0.004	0.004	2 – 5. 6 7 8***	0.006	0.004	2 – 4.5.6.7.8***
	2003	530	-0.008	0.003	3 – 4.5.6.7.8.9.10	-0.007	0.004	2 – 9**
	2004	260	-0.015	0.004	4 – 7***	-0.015	0.005	2 – 10*
	2005	557	-0.297	0.004	5 – 7*	-0.034	0.004	3-4. 5. 6. 7. 8. 9. 10***
	2006	77	-0.022	0.007		-0.025	0.008	4 – 7***
	2007	69	-0.161	0.007		-0.017	0.009	5 – 7***
	2008	16	-0.059	0.014		-0.075	0.017	
Season of farrowing	winter	460	0.001	0.002		-0.0003	0.003	
	spring	781	0.001	0.002		-0.0007	0.003	
	summer	456	0.002	0.003		0.003	0.003	
	autumn	791	-0.002	0.002		-0.002	0.002	

Levels of significance * (P≤0.05), **(P≤0.01), ***(P≤0.001).

Table 5

Heritability, phenotypic and genetic correlations of the studied traits

Traits	Number of born alive		Heritability
	r_p	r_g	h^2
Longevity	0.11±0.03	0.6±0.2	0.058±0.03
Service period	0.12±0.04	0.6±0.2	0.056±0.03
Number of born alive			0.278±0.05

Conclusions

The phenotypic variation of the sow longevity and the service period were significantly affected by the breed, litter (parity) and year of birth.

Low values of heritability for the studied traits (h^2 = 0.05) were specified.

Average to high values of genetic correlations (r_g= 0.6) was the reason to suppose that the selection according to born alive would positively affect on the sow longevity.

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