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BREEDING VALUE ESTIMATION ON SOME SELECTION TRAITS OF PERFORMANCE PRODUCTIVITY OF SMALL PIG POPULATIONS FROM THE DANUBE WHITE BREEDS

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Abstract

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Breeding value estimation was calculated on the basis of mixed-model, Animal model (sire model). The influence of the herd (replacement animals and culled animals), sex and year was studied. The fixed effects (F) of the herd, year, sex and random sire effect (R) were included in the structure of the model. The sire variance reflects j of the genetic variance and is represented as a genetic component of the model.

The phenotypic and genetic parameters of some more important traits of the performance test were analyzed. Genetic correlation was established between the lean meat percentage and the adjusted age r_g = 0.439.

The factors comprised by the model significantly reflect the variation of lean meat percentage in the carcass and the age of reaching 90 kg live weight R=0.953 and 0.986.

The selection carried out shows regular superiority of the pigs selected as replacement animals.

Key words: Animal model, phenotypic and genetic parameters, performance traits

Introduction

The traditional breeding programs are directed to genetic improvement of the performance traits of greater economic importance. The methodology of the mixed models applied by Animal model is a simultaneous estimation of the genetic and environmental effects taking into account the relationship between the individuals (Sorensen and Kennedy, 1986; Henderson, 1988; Kennedy et al., 1988; Meyer, 1989; Ferraz and Johnson, 1993). The mixed models worked out on the basis of complete covariance matrixes give an opportunity to compare animals from different herds (lines) and individuals in the same line (Kennedy et al., 1988). Newcom et al. (2005) compare three methods of breeding value estimation, emphasizing that the inclusion of additional information on close relatives increases the selection accuracy. The same authors recommend the use of models with single-trait or two-trait selection, and notice that the two-trait models are more suitable as their expected genetic progress is higher.

According to Woodward et al. (1993) the estimation of the components of covariance and additive variability is most important to determine the breeding value estimation. The construction of adequate linear statistical model, which completely describes the variation of traits, is of utmost importance.

Investigations with a limited excerpt of 24 pigs, where the sire is included as a random effect and the individual's sex is a fixed effect, were carried out in Bulgaria (Beremski et al., 1990). Results from the breeding value estimation by Animal model for pigs from the Large White and Landrace of English origin has been shown by Slanev (2007).

The objective of this investigation is to estimate the breeding value of some more important selection traits of the performance productivity of small populations of pigs from the Danube White breed.

Material and Methods

The results from the estimation by performance test of 563 pigs from the Danube White breed, originating from 46 sires, for three-year period (2004 – 2006) were analyzed. Testing was carried out at 90 kg live weight by apparatus Piglog 105. The phenotypic and genetic parameters of some more important traits of the performance productivity were established. Variance-covariance matrixes were constructed for the selection traits, which can be presented as follows:

VE

$$\begin{bmatrix} \sigma_{e(LM)} & \mathrm{cov}_{e(LM:AGE)} \\ \mathrm{cov}_{(LM\&AGE)} & \sigma_{eAGE} \end{bmatrix} \quad \text{(Harvey, 1990)}$$

VG

$$\begin{bmatrix} \sigma_{g(LM)} & \mathrm{cov}_{g(LM:AGE)} \\ \mathrm{cov}_{g(LM\&AGE)} & \sigma_{gAGE} \end{bmatrix}$$

VG – random variance-covariance of the sires
VE – environmental residual variance-covariance

The fat depths in the points L_1 and L_2 were included in the model structure as regression effects.

The breeding value estimation was performed on the basis of the sire model using PEST 3.1 software (Groenveld, 1990). The influence of herd (replacement and culled animals), sex and year was studied. The fixed effects (F) of the herd, year, sex and random sire effect (R) were included in the structure of the model. The sire variance reflects j of the genetic variance and is presented as a genetic component of the model.

Model

Lean meat percentage (LM) = herd, year, sex, sire
Adjusted age (Age) = herd, year, sex, sire

Results and Discussion

The results characterizing the lean meat percentage in the carcass and the age of reaching 90 kg live weight are given in Table 1. The obtained values of 49.17% and 261 are result of the traditional conditions of breeding. The variation of both selection traits is low (2.2-2.5%).

The influence of the factors (herd and year) is significant ($P \leq 0.001$). On the grounds of the high values of the determination coefficients (R = 0.953 and 0.968) we think that the factors included in the model reliably describe the variation of the selection traits. The regression coefficients between the basic selection traits and the other traits, measured simultaneously with the performance test are given in the same table. Negative correlations of the fat depth in point L_1 (4 cm from the spinal line at the last rib) and point L_2 (8 cm from the spinal line at the last rib) and the basic selection traits were estimated. The values characterizing the regression between the lean meat content and fat depth measured in the specific points are higher ($R_{(xy)}$ = -0.416 and -0.523). The results obtained confirm the fact that the chosen selection traits are in direct correlation with the other measured traits, which are subject to selection.

The genetic parameters characterizing the basic selection traits are given in Table 2. The genetic correlation between both selection traits ($r_g = 0.439$) gives us a reason to think that if selection is carried out on one of the traits this will lead to considerable improvements of the other trait. Most likely the low values of the phenotypic correlation are due to the environment.

Table 1
Results for some important selection traits from performance test

Factors	Level	Lean meat		Age-adjusted	
		LS mean	SE	LS mean	SE
Herd P?0,001*	Replacement animals	49.2	0.093	261.05	0.422
	Culled	49.14	0.091	260.99	0.411
Years P?0,001*	2004	49.33	0.135	260.35	0.608
	2005	49.31	0.092	261.95	0.414
	2006	48.96	0.088	259.33	0.399
MU		49.17	0.07	261.02	0.316
Variance		2.58		2.2	
Determination, R		0.953		0.986	
Regression with					
Fat depth L_1		-0.416	0.01	-0.116	0.046
Fat depth L_2		-0.523	0.01	-0.23	0.046

*Significance of factor by Fisher

Table 2
Estimation of genetic parameters for some selection traits

Traits	Heritability h^2±SE	Genetic correlation	Phenotypic correlation
		Age–adjusted, days	Lean meat LM, %
Lean meat LM, %	0.11 ± 0.09	0.439	-
Age adjusted, days	0.58 ± 0.16	-	0.101

Table 3
Ranking by the herd, sex and years

Level Traits	Herd		Level Traits	Sex		Level Traits	Years	
	Lean meat	Age		Lean meat	Age		Lean meat	Age
Replacement pigs	1.91	-17.4	Male	47.6	252.4	2004	1.4	21.49
Culled	0	0	Female	47.2	260.3	2005	0	0
						2006	0.83	12.98

It was established, with respect to the additive variability, that the age of reaching 90 kg live weight was a reliable criterion for carrying out selection (h^2 = 58%). Lower values than the expected ones were established for the lean meat percentage in the carcass, which was probably due to the high variation in the feeding and breeding conditions. The genetic (co)variances (which component is the additive variability) reliably reflect the breeding value in pigs. This can be illustrated by the ranking shown below.

Table 4
Ranking by the sire

Sire	Lean meat	Age	Sire	Lean meat	Age
522	-0.055	-0.604	4457	0.049	3.385
1402	-0.06	-1.399	4484	-0.047	1.586
1824	0.074	2.566	4504	0.117	2.803
2028	0.182	9.537	4509	0.05	3.191
2636	0.235	7.375	4517	0.23	0.222
2800	-0.035	-0.833	4523	0.008	-0.167
2802	-0.045	-2.334	4553	0.055	1.767
2818	-0.008	-1.912	4609	0.172	2.938
2826	-0.313	-13.224	4766	0.035	0.902
2857	0.169	2.077	4936	0.13	-1.238
2951	0.231	-0.539	5019	-0.274	-9.411
3247	0.071	1.397	5049	-0.011	0.964
3254	-0.151	-0.063	5157	-0.142	-4.338
3274	-0.257	-2.727	5222	-0.144	-7.2
3800	0.038	3.197	6461	0.035	0.759
4299	0.094	2.465	7290	-0.389	-9.529
4304	0.008	1.845	7309	-0.169	-1.049
4341	0.079	0.78	7409	0.102	4.489
4347	0.019	4.303	7806	-0.084	-6.196
4358	0.056	3.29	7842	0.062	1.49
4397	0.066	1.667	7945	-0.025	-1.572
4404	-0.005	1.298	9340	-0.018	-0.814
4416	0.009	-0.084	9534	-0.045	-1.062

The ranking on the basis of the fixed factors - herd, sex and year shows that the pigs selected as replacement animals had higher lean meat percentage (1.9%) and grew up more quickly by 17.4 days (Table 3). With respect to the influence of sex, it was established that young boars had insignificantly higher lean meat percentage (0.4%), while the growth rate was higher by 8 days. The same table gives information on the influence of the year. The most effective selection on these traits was in 2005.

The ranking of boars on the basis of their offspring shows the sires who were improvers or deteriorates. This information can be successfully used in the breeding process (Table 4).

Conclusion

The factors included in the model reliably reflect the variation of the lean meat percentage in the carcass and the age of reaching 90 kg live weight R=0.953 and 0.986.

The selection implemented shows regular superiority of the pig chosen for replacement animals.

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