

# GENETIC AND ENVIRONMENTAL PARAMETERS OF REPRODUCTIVE PERFORMANCES IN SWINE

## Les paramètres génétiques et du milieu pour les performances de reproduction chez les truies

## Genetische Parameter und Milieuparameter der Reproduktionsleistungen bei Schweinen

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### INTRODUCTION

The aim of this study is the determination of genetic and environmental parameters of reproductive performances in sows, because this performances have a great economical importance and must be included in a breeding program. In the same time the estimates of this parameters show a considerable range of variation.

### MATERIAL AND METHODS

The data were obtained from a Landrace population, with 356 sows, belonging to 23 family of paternal half-sisters. Were analysed 2118 litters. Effective population size was 14.7 and the mean rate of inbreeding of population is 0.034.

The characters who were studied are: number and mean of weight of piglets at birth, 4 and 8 weeks.

The components of variance were established using the analysis of variance, simultaneously in full—and half—sisters families, a model with three sources of variation being used.

For the determination of the heritability were used two methods: one based on dam-offspring regression and one based on halfsister's correlation.

The determination of the repeatability was made by two methods: one based by regression of one performance to a previous one and the other based by intraclass correlation.

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## RESULTS

The mean values of the six characters in the population considered were the followings:

— Number of pigs at birth ... ..	10.14 ± 0.034
» » » » 4 weeks ... ..	8.51 ± 0.037
» » » » 8 weeks ... ..	7.69 ± 0.048
— Average pig weight at birth ... ..	1.12 ± 0.003 Kg
» » » » 4 weeks ... ..	5.45 ± 0.017 Kg
» » » » 8 weeks ... ..	11.44 ± 0.062 Kg

The results obtained in determination of the causal components of variance, heritability and repeatability are presented in tables 1, 2, 3 and 4.

## DISCUSSION

*The components of variance.* The analysis of data presented in Table 1 permits us to take some interesting conclusion.

TABLE 1  
THE PRINCIPAL COMPONENTS OF PHENOTYPIC VARIANCE FOR REPRODUCTIVE PERFORMANCES IN SOWS

Variance component	Number of pigs at:			Average pig weight at:		
	Birth	4 weeks	8 weeks	Birth	4 weeks	8 weeks
Total phenotypic variance ... ..	0.764 100	0.815 100	1.465 100	0.00446 100	0.1701 100	2.266 100
Genotypic variance ... ..	0.115 15.1 %	1.112 13.7 %	0.168 11.5 %	0.00076 17.1 %	0.0323 19.0 %	0.448 19.7 %
Additive variance ... ..	0.096 12.6 %	0.092 11.3 %	0.132 9.0 %	0.00064 14.4 %	0.0284 16.7 %	0.388 17.1 %
Dominance variance ... ..	0.019 2.5 %	0.020 2.4 %	0.036 2.5 %	0.00012 2.7 %	0.0039 2.3 %	0.060 2.6 %
Environmental variance ... ..	0.649 84.9 %	0.703 86.3 %	1.297 88.5 %	0.00370 82.9 %	0.1378 81.0 %	1.818 80.3 %
General environmental variance.	0.071 9.3 %	0.062 7.6 %	0.090 6.1 %	0.00051 11.4 %	0.0179 10.5 %	0.326 14.4 %
Special environmental variance...	0.578 75.6 %	0.641 78.7 %	1.207	0.00319 71.5 %	0.1199 70.5 %	1.492 65.9 %

a) For both groups of characters (number of pigs and average pig weight) the phenotypic variance increases with the level of age. These increase is not the same for the two groups of characters. An explanation of this differentiation

could be the following: the weight of offsprings in an individual character who is subject to multiple influences of environment, while the variation of number is a variation of a group.

b) The genotypic variance has a contrary tendency for the two groups of characters. While the genotypic variance of number of pigs decreases from 15.1 % at birth to 11.5 % at 8 weeks, the genotypic variance of the average pig weight increases from 17.1 % at birth to 19.7 % at 8 weeks.

c) The additive variance, who is the main component of the genotypic variance, has the same tendency with this.

d) The dominance variance generally presents little values into the phenotypic variance, and it is quite constant.

e) The environmental variances represent for all the characters the main components of the phenotypic variance. It is noticeable that the quantum of the special environmental variance is greater for the number than for the average pig weight. The quantum of the special environmental variance increases from birth to 8 weeks for litter size and decreases for the mean of weight.

*Heritability.* The low heritability estimates are in agreement with the results of other workers. One may notice, by an analysis of the data presented in table 2, that the heritability of the number of pigs is greater at birth and decreases to 4 and to 8 weeks. This tendency may be explained by the fact that the loss of the piglets depends in a great measure upon the environment.

TABLE 2

HERITABILITY ESTIMATES FOR THE SIX CHARACTERS, OBTAINED BY THE THREE METHODS USED

Characters	Method			Mean
	Regression		Analysis of variance	
	I	II		
Number of pigs at:				
Birth ... ..	0.140 ± 0.304	0.144 ± 0.282	0.126 ± 0.169	0.137
4 weeks ... ..	0.136 ± 0.192	0.138 ± 0.180	0.113 ± 0.183	0.129
8 weeks ... ..	0.128 ± 0.122	0.134 ± 0.096	0.090 ± 0.178	0.117
Average pig weight at:				
Birth ... ..	0.162 ± 0.176	0.170 ± 0.156	0.144 ± 0.174	0.159
4 weeks ... ..	0.170 ± 0.124	0.178 ± 0.120	0.167 ± 0.180	0.172
8 weeks ... ..	0.190 ± 0.192	0.204 ± 0.170	0.171 ± 0.188	0.188

Concerning the heritability of the average pig weight at different ages one may notice, a contrary tendency, the smallest values beeing at birth, and increasing to 4 and 8 weeks. This tendency may be explained by the fact that the individual weight depends mainly on the proper genotype, and on genotype—environment interaction, than the mother's organism.

*Repeatability.* The analysis of the data presented in table 3, points out that the reproductive performances of the sows have generally lower repeatability, because they are submitted in a striking way to the action of special environmental conditions.

TABLE 3  
REPEATABILITY ESTIMATES FOR THE SIX CHARACTERS

Characters	Method		
	Regression	Intraclass correlation	Mean
Number of pigs at: birth	0.144	0.143	0.144
4 weeks	0.135	0.139	0.137
8 weeks	0.126	0.121	0.124
Average pig weight at: birth	0.167	0.173	0.170
4 weeks	0.179	0.184	0.182
8 weeks	0.197	0.202	0.200

The low repeatability estimates obtained are also in accordance with those found by others workers.

The repeatability estimates of the number of pigs decrease gradually from the birth to 8 weeks while the repeatability estimates of average pig weight increase from birth to 8 weeks.

With regard to the gain in accuracy that may be expected from multiple measurements, the data presented in table 4, point out that this gain is maximum for the first 3-4 performances, after that it falls off with every new performance.

TABLE 4  
THE VARIATION OF THE RATIO  $V_{F_n} / V_F$  FOR

Number of performances	The value of the ratio $V_{F_n} / V_F$ for					
	Number of pigs at:			Average pig weight at:		
	Birth	4 weeks	8 weeks	Birth	4 weeks	8 weeks
1	1	1	1	1	1	1
2	0.572	0.569	0.562	0.585	0.591	0.600
3	0.429	0.425	0.416	0.447	0.455	0.467
4	0.358	0.355	0.343	0.377	0.386	0.400
5	0.315	0.310	0.299	0.336	0.345	0.360
6	0.286	0.281	0.270	0.308	0.318	0.333
7	0.266	0.260	0.249	0.288	0.299	0.314
8	0.251	0.245	0.233	0.274	0.284	0.300
9	0.239	0.233	0.221	0.262	0.273	0.289
10	0.229	0.223	0.211	0.253	0.264	0.280

That means, that for the selection of sows one may establish the phenotypic value only by the first three performances. In this way one may reduce the generation interval.

## SUMMARY

The partitioning of the phenotypic variance into its genotypic and environmental components and estimate of heritability and repeatability have been done for several characters in swine (number of pigs at birth, 4 and 8 weeks and average pig weight at birth, 4 and 8 weeks). Data were available from 2118 litters, obtained from 356 sows belonging to 23 families of paternal half-sisters.

The characters concerning number and average pig weight at various ages are found to have a low level of genetical determination, generally from 10 to 15% for litter size and from 15 to 20% for mean of weight. The most part of the environmental variance is due to the special environment (90-95% for number and 85-90% for mean of weight of piglets).

The estimates of the heritability have various values, from 0.117 (number of piglets at 8 weeks) to 0.188 (mean of weight at 8 weeks).

The values of the repeatability are different, from 0.124 (number of piglets at 8 weeks) to 0.2 (mean of weight at 8 weeks).

## RESUME

Ils ont été déterminés les composants de la variance, l'héritabilité et la répétabilité pour six caractères: (taille de la portée et le poids moyen des porcelets à la naissance, 4 et 8 semaines). Ils ont été utilisés les résultats des 2118 portées.

Les caractères concernant le nombre et le poids moyen des porcelets à la naissance et à différents âges sont en général les caractères avec une faible déterminisme génétique, 10-15% pour le nombre total de porcelets, et 15-20% pour le poids moyen de porcelets. L'action du milieu spécial dans le total du milieu est très grande, 90-95% pour le nombre de porcelets par portée et 85-90% pour le poids moyen de porcelets.

Les évaluations de l'héritabilité varient de 0,117 (pour le nombre de porcelets à 8 semaines) à 0,188 (pour le poids moyen à 8 semaines).

Les évaluations de la répétabilité varient de 0,124 (pour le nombre de porcelets à 8 semaines) à 0,2 (pour le poids moyen à 8 semaines).

## ZUSAMMENFASSUNG

Es wurden die kausalen Komponenten der Varianz, die Erbllichkeit und Repeatabilität für 6 Charakteristika (Anzahl und Durchschnittsgewicht der Ferkel bei der Geburt, nach 4 und 8 Wochen) auf Grund der Ergebnisse von 2118 Würfen der 356 Sauen, die 23 Familien von väterlichen Halbschwestern angehörten, bestimmt.

Die Charakteristika betreffend die Anzahl und das Durchschnittsgewicht der Ferkel im verschiedenen Alter sind im allgemeinen Charakteristika mit geringem genetischen Determinismus, im allgemeinen 10-15% für die Anzahl der Ferkel und 15-20% für das Durchschnittsgewicht bei einem Abwurf. Im Rahmen des massiven Einflusses der Umwelt spielt das spezielle Medium eine grosse Rolle, 90-95% auf die Anzahl der Ferkel und 85-90% auf das Durchschnittsgewicht der Ferkel.

Die Werte für die Erblichkeit liegen zwischen 0,117 (Anzahl der Ferkel nach 8 Wochen) und 0,188 (Durchschnittsgewicht nach 8 Wochen).

Die Werte für die Repetabilität liegen zwischen 0,124 (Anzahl der Ferkel nach 8 Wochen) und 0,2 (Durchschnittsgewicht nach 8 Wochen).

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