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GENETIC DETERMINISM OF THE REPRODUCTION TRAITS IN A PLYMOUTH ROCK LINE

DETERMINISMUL GENETIC AL CARACTERELOR DE REPRODUCȚIE LA O LINIE DIN RASA PLYMOUTH ROCK

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The heritability of the studied traits was below 0.2 in four traits (age at first egg, body weight, eggs produced during the control period, laying percentage during the control period); only egg weight having a higher heritability, 0.698. There are tight positive phenotypic, genotypic and environmental correlations between the egg number and the laying percentage and tight negative correlations between the age at first egg and the egg number and between the age at first egg and the laying percentage.
Keywords: genetic determinism, reproduction traits, layers

Introduction

The reproduction traits have a double importance in terms of improvement: they are useful economically and could thus be included among the objectives of improvement, and they also influence directly the efficiency of selection.

Broiler meat production is done almost everywhere in the world by two breeds: Cornish as paternal line and white Plymouth Rock as maternal line. The genetic parameters vary with the genetic structure of the population and with the exploitation conditions which have to be studied in each population which is source for improvement.

The purpose of research is the study of the genetic determinism of the reproduction traits in the Plymouth Rock 010 maternal line.

Material and Methods

The biological material used in the study comes from Avicola Tărtăşeşti, being hens belonging to a maternal line used to produce broiler hybrids, a Plymouth – Rock line.

The analysis of the genetic determinism of some reproduction traits used the performance data obtained from 668 hens belonging to 288 families of full sisters and to 40 families of paternal half-sisters.

The following reproduction traits was measured: *age at first egg, body weight, eggs produced during the control period, laying percentage during the control period and egg weight at 30 weeks.*

We used the method of the causal components of the variance to determine the heritability and the variance and covariance analyses to determine the value of the three categories of correlations (phenotypic, genotypic and environmental).

I. Causal components of the variance.

We used the following statistic model: (Snedecor, Sandu)

$$X_{ijk} = \mu + A_i + B_{ij} + C_{ijk}$$

where:

X_{ijk} = performance of individual k, obtained from hen j mated to cock i

μ = mean performance of the analyzed sample

A_i = effect of cock i

B_{ij} = effect of hen j mated to cock i

C_{ijk} = effect of other sources which can affect the performance of individual k

The model was solved by a variance analysis with three sources of variance (between families of half-sisters, between families of full sisters, intra-families of full sisters).

II. Evaluation of heritability for the reproduction traits in the analyzed population.

The method of causal components was used to determine heritability, by which: $h^2 = \frac{V_A}{V_F}$

III. Phenotypic, genotypic and environmental correlations of the reproduction traits

We used the following methodology to evaluate the three categories of correlations (phenotypic, genotypic and environmental):

1) Variance analysis with three sources of variance (between families of half-sisters, between families of full sisters, intra-families of full sisters) for both traits under consideration.

2) Covariance analysis in families of half sisters for the couple of traits under consideration.

3) The following correlation formulas were used: $r_{F_{XY}} = \frac{\text{cov}_{F_{XY}}}{\sqrt{S^2_{F_X} \cdot S^2_{F_Y}}}$

$$r_{G_{XY}} = \frac{\text{cov}_{I_{XY}}}{\sqrt{S^2_{I_X} \cdot S^2_{I_Y}}} \qquad r_{M_{XY}} = \frac{\text{cov}_{i_{XY}} - 2\text{cov}_{I_{XY}}}{\sqrt{(S^2_{i_X} - 2S^2_{I_X}) \cdot (S^2_{i_Y} - 2S^2_{I_Y})}}$$

(Robertson, Lush, Drăgănescu)

Results and Discussions

The genetic variability determined by the additive effect of the genes from the polygenic complexes of the five traits determines obvious differences between the five traits. Thus, the genetic variability determined by the additive variance represents only 7.48% of the total variance for the *egg number*, while it represents 69.8% for the *egg weight* (over five times more). The proportions of the additive variation for the traits *age at first egg* and *laying percentage* are almost equal (16.08% and 17.98%). For the *body weight* the proportion of the additive variance out of the total variance (11.68%) is quite small.

The emerging conclusion is that except for *egg weight*, the variability of the other traits is poorly influenced by the additive effect of the genes.

The causal components of the phenotypic variance are shown in Table 1.

Table 1

The causal components of the phenotypic variance for the studied traits

Trait	V_F	V_A	V_D	V_{Mg}	V_{Ms}
Age at first egg	100.47 *100.00 %*	16.16 *16.08 %*	2.22 *2.21 %*	9.36 *9.32 %*	72.73 *72.39 %*
Body weight	3597.38 *100.00 %*	420.08 *11.68 %*	111.12 *3.09 %*	473.31 *13.16 %*	2592.87 *72.08 %*
Number of eggs during the control period	52.17 *100.00 %*	3.90 *7.48 %*	1.26 *2.41 %*	2.53 *4.85 %*	44.48 *85.26 %*
Laying percentage	101.28 *100.00 %*	18.21 *17.98 %*	1.78 *1.76 %*	6.60 *6.52 %*	74.69 *73.74 %*
Egg weight at 30 weeks	14.90 *100.00 %*	10.4 *69.80 %*	0.14 *0.94 %*	1.18 *7.92 %*	3.18 *21.34 %*

Heritability was determined using the causal components of the variance. Table 2 shows the results.

Table 2

Heritability of the studied traits

Trait	$h^2 \pm S_{h^2}$
Age at first egg	0.160 ± 0.089
Body weight	0.117 ± 0.079
Egg number	0.075 ± 0.070
Laying percentage	0.180 ± 0.093
Egg weight at 30 weeks	0.698 ± 0.209

A first observation is that four of the five traits (*age at first egg, body weight, egg number* and *laying percentage*) are poorly heritable traits, the value of their heritability being lower than 0.2. Only *egg weight* is an intensely heritable trait.

Different authors have monitored the genetic parameters evaluated for certain traits, reproduction included, as causality elements for the variability of the various hen populations. For the age at the first egg, the values of heritability found in the literature ranged between 0.05 (Iuliana Neagu, 1996) and 0.51 (Hogsett 1964, cited by Van, I., 2000). For the body weight, Van, I. obtained a heritability coefficient of 0.26 for the egg number, while Sandu, Gh. obtained a heritability of 0.25. Popescu-Vifor and Poşircă determined a heritability of 0.24 for the laying percentage. These parameters vary with the genetic structure of the population and with the exploitation conditions, so that these parameters have to be studied for every population undergoing improvement.

Table 3 shows the phenotypic, genotypic and environmental correlations of the studied traits.

Table 3

Genotypic and environmental correlations

Couple of traits	r_F	r_G	r_M
Age at first egg (A) ×			
- body weight (B)	0.097	-0.319	0.166
- egg number (C)	-0.612	-0.778	-0.597
- laying percentage (D)	-0.456	-0.639	-0.420
- egg weight (E)	0.094	-0.167	0.245
Body weight (B) ×			
- egg number (C)	-0.202	0.172	-0.244
- laying percentage (D)	-0.007	- 0.118	0.012
- egg weight (E)	0.141	0.542	-0.015
Egg number (C) ×			
- laying percentage (D)	0.980	0.818	1.011
- egg weight (E)	-0.189	- 0.406	-0.169
Laying percentage (D) ×			
- egg weight (E)	-0.064	- 0.309	0.054

Poor positive phenotypic correlations were noticed between the age at first egg and the body weight, the age at first egg and egg weight, and a tight positive correlation between the egg number and the laying percentage.

Tight negative phenotypic correlations were obtained between the age at first egg and the egg number, between the age at the first egg and the laying percentage; poor phenotypic correlations were noticed between the body weight and the egg number, between the body weight and the laying percentage, between the egg number and the egg weight, between the laying percentage and the egg weight.

Positive genotypic correlations were observed between the body weight and the egg number, between the body weight and the egg weight, between the egg number and the laying percentage. Negative genotypic correlations were observed between the age at first egg and the other four traits, and between the body weight and the laying percentage and between the laying percentage and the egg weight.

Positive environmental correlations were noticed between the age at first egg and the body weight, between the age at first egg and the egg weight, between the body weight and the laying percentage, between the egg number and the laying percentage, between the laying percentage and the egg weight. Significant negative environmental correlations were noticed between the age at first egg and egg number, between the age at first egg and the laying percentage; poorly negative environmental correlations were observed between the body weight and the egg number, between the body weight and egg weight and between the egg number and egg weight.

Conclusions

The following conclusions resulted from the study of the reproduction traits in the analyzed population:

1. Four of the five traits (age at first egg, body weight, egg number and laying percentage) were poorly heritable, with a heritability value below 0.2. Only egg weight was intensely heritable (0.698).

2. Tight positive phenotypic, genotypic and environmental correlations were noticed between the egg number and the laying percentage (0.980, 0.818 and 1.011).

3. Tight negative correlations were noticed between the age at first egg and egg number (-0.612, -0.778, -0.597) and between the age at first egg and the laying percentage (-0.456,-0.639, -0.420).

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