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ASSESSMENT OF NON-GENETIC EFFECTS ON THE FATTENING AND SLAUGHTER TRAITS FOR DANUBE WHITE PIGS BASED ON THE PERFORMANCE TEST EVALUATION

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Abstract

An evaluation based on performance tests was carried out on 639 male and female (castrated) animals from the Danube White breed in Agricultural Institute Shumen. The testing of animals was done at 90 kg live weight with the "Pig log 105" apparatus. Significant sources of specific variance in different levels of probability were established for line, year, sex and replacement animals. Significant effects of sublevels of the studied environmental factors were also established. The results, presented by us, emphasized the necessity of fixed trait evaluations and determination of their effects during the genetic evaluation of the Danube White population.

Key words*: Danube White pigs, environmental effects, performance test.*

INTRODUCTION

Swine from the Danube White breed were locally selected, with a narrow range and limited number of animals – two herds with around 500 swine. In recent years, there have been significant changes in fattening and slaughter qualities that make animals competitive on the internal market. A large number of studies for assessing the origin influence, year of testing, season and, mostly, the effect of gender on the evaluated performance traits have been available. In some of the studies, differences between the slaughter traits in males and females were not found (Alonso et al., 2009; Gispert et al., 2010), while other authors pointed out that meat qualities were influenced by gender (Bridi et al., 2006; Franco et al., 2008). Significant influence on traits characterizing growth capabilities was caused by origin, herd, year of testing and their interaction.

The selective breeding programs in pig farming used variation rates to improve fattening and slaughter traits. Variation in turn was represented by genetic and environmental components. Environmental variation, although not transferred from the parents to the offspring, has been essential for the productivity of the tested animals. The assessment of non-genetic factors gives assistance to the standardization and productivity organization (management) (Dube et al., 2011). Therefore, using environmental factors in pig breeding plans has been imperative (Habeanu et al., 2018). Numerous similar studies for assessing the influence of non-genetic effects have been available (Mungate et al., 1999; Serrano et al., 2008).

Occasional monitoring of the breed has been imposed by the market supply and demand, which influences selection.

The aim of this research was to study some non-genetic effects on fattening and slaughter traits for Danube White pigs based on the performance test evaluation

MATERIALS AND METHODS

The study was carried out in the period 2013-2019 in Agricultural Institute - Shumen. The animals were fed with fodder mixtures for the corresponding category according to Bulgarian State Standards. The animals were provided with adequate floor space for movement.

An evaluation based on performance tests of 639 male and female animals from the Danube White breed was made. Animal testing was carried out at 90 kg live weight with Pig log 105 apparatus; for each kilogram below or over 90 kg was added or deducted 0.7 days from the age according to the Regulation for Evaluation

of Breeding Value, Productivity and Classification of Breeding Pigs, Shumen.

The analyzed traits were: backfat thickness in points X_1 and X_2, thickness of *Musculus longissimus dorsi* (MLD) and growth rate intensity to 90 kg live weight.

Backfat thickness in point X_1 (located between the third and fourth lumbar vertebra, 7 cm from the medial line) and X_2 (located between the last third and fourth ribs, 10 cm from the medial line).

Data processing was made with LSMLMW MIXMDL software, version Pc-2.

The following statistical model was used:

$$\gamma = \mu + L_{i(1-8)} + Y_{j(1-7)} + R_{k(1-2)} + S_{i(1-2)} + e_{(i-)}$$

where: μ - average

L - Fixed line effect;

Y - Fixed year effect;

R - Fixed effect of replacement animals;

S - Fixed gender effect;

e - Residual effect.

The reliability of differences between the levels of studied factors was established according to distribution levels by Student (Hayter, 1984).

RESULTS AND DISCUSSIONS

Results from the performance test evaluation and the analysis of variance for productive traits are shown in (Table 1). Analysis of the results for the backfat thickness traits in points X_1 and X_2 present the same range from 11 to 15 mm. *Musculus longissimus dorsi* (MLD) was 44.45 mm and the age at 90 kg live weight was 205 days.

Statistically significant sources of specific variance with different rates of probability were established for all studied factors. The chosen replacement animals for own breeding have had significant and highly significant effect on traits: back fat thickness in point X_2 ($P \leq 0.05$) and age at 90 kg live weight ($P \leq 0.01$).

Gender had significantly influenced all of the studied traits including back fat thickness in point X_1 and age, as well as *Musculus longissimus dorsi* (MLD) thickness and X_2 ($P \leq 0{,}05$). Origin based on lines had a significant influence for the back fat thickness trait in point X_2 ($P \leq 0.05$), while no significant differences were established for the other traits. Regarding the year of testing trait, significant and highly significant effect was established for the following traits: back fat thickness in point X_2, *Musculus longissimus dorsi* (MLD) thickness and age at 90 kg live weight ($P \leq 0.01$, $P \leq 0.001$).

Determination coefficient were with comparatively high values for the backfat thickness trait in points X_1 and X_2 and age at 90 kg live weight ($R^2 = 0.77$, $R^2 = 0.81$, $R^2 = 0.66$) which showed that the studied factors accurately reflects the trait variations in the model. Regarding *Musculus longissimus dorsi* (MLD) thickness, this indicator was with low values.

Table 1. Results from the performance evaluations and variance analysis of the studied factors

Traits	Number, n/degree of freedom df	Backfat thicknes		*Musculus longissimus dorsi*, mm	Age, days
		X_1	X_2		
$\bar{X}$		15.20	11.76	44.45	205
SD		4.18	3.17	4.91	27.82
CV		13.22	12.00	9.41	8.06
R		0.77	0.81	0.30	0.66
Total	639				
Total reduction	88				
Replace-ment	1	n.s	*	n.s	***
SEX	1	**	*	*	**
Line	7	n.s	+	n.s	n.s
Year of test	6	n.s	***	**	***

Significance of differences: *** - P≤0.001, ** - P≤0.01, * - P≤0.05; n.s. - no significances

Influences of the line, year of testing, number of called and replacement animals and gender on studied traits from the evaluation for individual productivity are indicated in (Table 2).

It was established that the thinnest fat was in point X_2 in pigs from the first line (11.5 mm) as differences between them and those from fifth and seventh line were significant and highly significant ($P \leq 0.05$, $P \leq 0.01$).

Significant differences were established for the same trait between the fifth and seventh line with the second, third and sixth ($P \leq 0.05$). Backfat thickness in point X_1 was the thinnest in line seven, as differences with first, second and third line were significant ($P \leq 0.05$).

The same degree of significance was established in third line with fourth and fifth

(P≤0.05). *Musculus longissimus dorsi* (MLD) thickness was with the highest values in the seventh line (45.42 mm). The highly significant differences between the seventh line with first and second were P≤0.01, but those with third, fourth and fifth were with significance of P≤0.05. For the same trait were established significant differences between sixth line with first, second and fourth (P≤0.05).

Regarding the trait for growth rate intensity to 90 kg live weight, it was established that age had the lowest values for line eight (203 days) and between her and the other lines small and insignificant differences were established.

Differences between years of testing, presented in the same table, were significant and highly significant in regards to almost all studied traits (P≤0.01, P≤0.001), except backfat thickness in point X_1.

Backfat thickness in point X_2 was the thinnest in 2014 (11.38 mm) and between that year and 2013, 2018 and 2019, differences with high significance were established (P≤0.001). *Musculus longissimus dorsi* (MLD) thickness was with the highest values in 2019 (46.69 mm) and age at 90 kg live weight was also the lowest values in 2019 (194 days), as the differences between them and other years were significant (P≤0.001).

An intensive increase (11 days) was established in replacement animals compared to the rest of the studied population (P≤0.001).

In regards to gender, significant differences were established for the *Musculus longissimus dorsi* (MLD) thickness and age at 90 kg live weight traits (P≤0.01). The established regularly regression values of the studied traits backfat thickness in points X_1 and X_2, *Musculus longissimus dorsi* (MLD) thickness and age at 90 kg live weight were small and insignificant.

Growth intensity and lean meat content from farrowing up until the end of the test period was determined by growth and muscle fiber characteristics (Larzul et al., 1997; Gentry et al., 2004).

The influence from the environment on the performance productivity tests suggested presence of differences for the studied fattening and slaughter traits. These differences often occur due to changes in raising during different seasons and years, work organization, which requires optimization of procedures for swine raising and selection.

Dube et al. (2011) established similar results to ours in regards to fattening and slaughter traits, which were significantly influenced by year of testing (P≤0.001).

In regards to the daily gain, respectively, growth intensity was better in female animals, where as in our study male castrated pigs were characterized by higher growth intensity with approximately 6 days.

Similar results were established by Augspurger et al. (2002), where males had more intensive growth rates. The established significant differences for the studied traits between separate years were probably due to differences in the conditions of the production process and organization.

In our study no substantial differences were established, in regards to fat thickness between the two genders. In unison with our results, Lee et al. (2019) did not establish essential differences in backfat thickness, while Dube et al. (2011) found that the male animals were characterized by thinner backfat compared to females (P<0.001). Similar results in which male swine had a higher content of hypodermic fat were established by Cassady et al. (2004) and Bahelka et al. (2007).

Table 2. Factor influence on the studied traits

Factors		n	Backfat thickness, mm		MLD, mm	AP, day	X_1	X_2	MLD	AP
			X_1	X_2						
LSC		639	14.54±0.25	12.08±0.18	43.73±0.53	209.1±2.11				
Line	1	91	14.97±0.42	11.54±0.29	43.17±0.88	212.0±3.49	1-7*	1-5*	1-6*	
	2	94	15.04±0.48	11.71±0.34	43.02±1.01	210.4±4.01	2-7*	1-7**	1-7**	
	3	92	15.16±0.45	11.60±0.31	43.67±0.93	207.8±3.72	3-4*	2-5*	2-6**	
	4	114	14.34±0.45	12.11±0.31	43.29±0.93	209.4±3.71	3-5*	2-7*	2-7**	
	5	102	14.27±0.43	12.32±0.30	43.62±0.90	208.3±3.58	3-7*	3-5*	3-7*	
	6	116	14.74±0.39	11.94±0.27	44.25±0.81	208.8±3.24		3-7*	4-6*	
	7	19	13.58±0.65	13.10±0.46	45.42±1.36	213.1±5.41		6-7*	4-7*	
	8	11	14.23±0.71	12.28±0.50	43.39±1.49	203.1±5.92			5-7*	
YT	2013	110	14.27±0.36	12.68±0.25	43.28±0.76	217.6±3.03		1-2***	1-6,7***	1-2, 5, 7***
	2014	108	14.86±0.41	11.38±0.29	42.73±0.86	218.3±3.42		1-3*	2-4**	2-3, 5, 7***
	2015	44	14.35±0.50	11.89±0.35	42.13±1.04	198.0±4.12		1-5**	2-6, 7***	3-4, 6***
	2016	155	14.95±0.35	11.86±0.24	44.08±0.73	217.6±2.91		2-6, 7***	3-4, 6, 7***	4-5, 7***
	2017	65	14.40±0.42	11.65±0.30	42.30±0.89	201.8±3.53		4-6, 7*	4-5,7***	6-7***
	2018	115	14.40±0.38	12.40±0.27	44.89±0.80	215.9±3.17		5-6, 7*	4-6*	5-7*
	2019	42	14.54±0.52	12.68±0.36	46.69±1.08	194.2±4.29			5-6, 7***6-7*	6-7***
REM	1	451	14.70±0.26	11.89±0.18	43.60±0.55	203.4±2.20				***
	2	188	14.38±0.28	12.26±0.20	43.86±0.59	214.7±2.35				
SEX	1	85	14.08±0.33	12.26±0.23	43.16±0.68	206.0±2.73			**	**
	2	554	14.10±0.24	11.89±0.17	44.30±0.51	212.1±2.04				

Significance of differences: *** - P≤0.001, ** - P≤0.01,* - P≤0.05

CONCLUSIONS

Results from the study on non-genetic effects on the lifetime assessment of fattening and slaughter traits for Danube White pigs established that optimal conditions for raising and managing were a necessary requirement for effective selection.

Significant sources of specific variance in different levels of likelihood were established for the studied traits: replacement, sex, line and year of testing.

The results, presented in this research, emphasized the necessity of fixed trait evaluations and determination of their effects during the genetic evaluation of Danube White population.

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