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Faculty of Animal Productions Engineering and Management

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ADAPTATION LEVEL, MANAGEMENT VALUE AND PRODUCTIVITY OF LARGE WHITE SOWS OF HUNGARIAN ORIGIN IN THE STEPPE ZONE OF UKRAINE

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Abstract

The paper presents the results of a study of long-term adaptation, management value and productivity of Large White sows of Hungarian origin in the conditions of steppe zone of Ukraine. It was found that Large White sows of Hungarian origin are characterized by high rates of long-term adaptation, management value and reproductive qualities. Thus, their age of life is 44.1 ± 1.97 months (Cv = 35.27%); the duration of breeding use is 32.8 ± 1.95 months (Cv = 46.91%); the index "level of adaptation" varies in the range from 5.48 to 27.20 points. Taking into account the intra-breed differentiation according to the index "level of adaptation", a significant difference between the groups of sows of class M + and M- was found according to the following indicators: "farrowing received", "live piglets in total, heads", "multifetation, heads", "nest weight during the weaning at the age of 28 days, kg". The indicator "livability of piglets before weaning at the age of 28-32 days, %" in the experimental groups of sows ranges from 90.1 to 94.4%. Sows from the category "high management value" exceeded peers from the category "low management value" in terms of "farrowing received", "live piglets in total, heads", "multifetation, heads", "nest weight during the weaning at the age of 28-32 days, kg" by 46.67% on average. The indicator "livability of piglets before weaning at the age of 28-32 days, %" in different management value groups of sows ranges from 91.3 to 100.0%. The maximum increase in additional products was obtained from sows which index "level of adaptation" ranges from 5.48 to 8.20 points (+4.99%), as well as from animals of the category "high management value" (+3.41 %), respectively. These indicators are proposed to be used as criteria for selection of highly productive animals in the controlled population.

Key words*: adaptation, breed, correlation, economic efficiency, management value, reproductive qualities, sow, variability.*

INTRODUCTION

An objective assessment of the level of pig adaptation to environmental conditions, management value and productivity indicators is the relevant issue in working with the population of animals of a particular breed (Shulga et al., 2011; Topikha & Konovalov, 2009; Khalak et al., 2021; Khalak, 2009, 2020; Khokhlov et al., 2011; Kislinskaia et al., 2012).
Thus, according to Dudka (2020), it was established that sows of the Ukrainian Spotted Steppe breed in the process of ontogenesis adapt better to breeding conditions and to the environment. This is manifested in an increase in age of life and breeding use of sows from the main herd and a reduction in the adaptation index. The age of life of sows of the Ukrainian White Steppe breed is 35.7 months, the duration of breeding use is 21.9 months, the adaptation index is 37.7 points. The author notes that the high level of adaptability of genotypes from the studied breeds to breeding conditions is confirmed by the results of

assessment of their management value, which is 22.3-35.3 heads per one sow for all viable piglets, and it meets the requirements of the "average" level at scale for assessing the management value of sows.

Important population indicators are flexibility and stability of pigs, which depend on the genotype (Dudka, 2020). The author identified four highly flexible (bi = 3.020-4.601) lines with a positive genotypic effect (0.11-0.44 heads) in the Ukrainian Spotted Steppe breed and two (bi = 1.545-1.683 and 0.12-0.21 heads) in the Ukrainian White Steppe breed. It is proved that lines with a combination of high flexibility and low stability should be used in further breeding work to increase the genetic potential of animals, and low flexibility and high stability to consolidate the breeding traits of breeds.

It is established that in the process of adaptation in the herd replacements of Large White breed of Hungarian origin in the Black Sea region there is a decrease in growth, development and productivity for three consecutive generations. The most significant decrease in the above mentioned indicators is specific to the second generation of descendants of imported animals (Kislinska, 2012). The process of adaptation has negatively affected the level of reproductive qualities of the sows being tested. The lowest rates were obtained in the first generation of animals compared to the generation of acclimatizers. But with each following generation, an increase in these indicators was found, the maximum manifestation of which was found in the third generation of animals.

The works of other native and foreign scientists are confirmation of the relevance of the chosen research area (Khalak, 2020; Vashchenko et al., 2015; Kovalenko, 2011; Berezovskyi, 2014; Vashchenko, 2011; Tolokontsev, 2010; Kislinskaia et al., 2012).

The aim of the work is to investigate the indicators of long-term adaptation, management value and productivity of sows of Large White breed of Hungarian origin in the steppe zone of Ukraine, and based on the obtained data, to determine the criteria for selection of highly productive animals according to the index "level of adaptation" and calculate the economic efficiency of research results.

MATERIALS AND METHODS

The experimental part of the work was carried out on farms in Dnipropetrovsk region and in the laboratory of the State Institution "Institute of Grain Crops of NAAS of Ukraine". The work was performed according to the research program of NAAS of Ukraine № 31 "Genetic improvement of farm animals, their reproduction and conservation of biodiversity (Genetics, conservation and reproduction of biological resources in animal husbandry)", task "To determine the adaptive features and nature of inheritance of polygenic-hereditary traits of pigs of different genotypes and to develop an integrated system for creating a highly productive population".

Large White sows of Hungarian origin are the object of the study.

Evaluation of sows on the indicators of long-term adaptation, management value of reproductive qualities was carried out taking into account the following quantitative characteristics: "age of life of sows, months"; "duration of breeding use of sows, months"; "farrowing received"; "piglets in total, heads"; "live piglets in total, heads"; "multifetation, heads"; "nest weight during the weaning at the age of 28 days, kg"; "livability of piglets before weaning, %". Comprehensive assessment of sows on the indicators of reproductive qualities was carried out according to the index of M.D. Berezovskyi (quoted Vashchenko, 2019):

$$I = B + (2 \times W) + (35 \times G) \quad (1)$$

where: I - M.D. Berezovskyi index, points; B - the number of piglets at birth, heads; W - the number of piglets at the time of weaning, heads; G - average daily gain of live weight of piglets before weaning, kg.

The index "level of adaptation" was calculated according to the following method:

$$ILA = \frac{AL^2}{farrowings \times DBU\ (months)}, \quad (2)$$

where: ILA - index "level of adaptation", points; AL - age of life of sows (from birth to the last weaning of piglets), months; DBU - duration of breeding use (from the beginning of the first gestation to the last weaning of piglets), months (Smirnov, 2003).

The management value of sows was determined by the Koriazhnov scale (1983) (Table 1).

Table 1. The scale of management value of sows

The level of management value	Management value per farrowing sow		Management value per inseminated sow	
	E_1 (piglets in total)	E_1 (including viable)	E_2 (piglets in total)	E_2 (including viable)
Low	Up to 25	Up to 20	Up to 25	Up to 15
Medium	26-40	21-30	21-44	16-34
High	more 50	more 40	more 45	more 35

The cost of additional products was calculated by the following formula:

$$Å = P \times \frac{A \times M}{100} \times L \times N, \quad (3)$$

where: A - cost of additional products, UAH; P - purchase price per unit of output, according to existing current prices in Ukraine; A - average productivity of animals; M - the average raise of the main product (%), which is expressed as a percentage per 1 head when applying a new and improved breeding achievement compared to the productivity of animals of basic use; L - constant coefficient of reduction of the result, which is associated with additional costs for profitable products (0.75); N - the number of livestock of new or improved breeding achievement, heads ("Methods of determining the economic…", 1983).

Biometric processing of the obtained material was performed according to the methods of Kovalenko et al. (2010), using the software module "Data Analysis" in Microsoft Excel

RESULTS AND DISCUSSIONS

The research results show that Large White sows of Hungarian origin in the steppe zone of Ukraine are characterized by high rates of long-term adaptation (Table 2). Thus, their age of life is 50.1, the duration of breeding use is 41.9 months. The "adaptation level" index is 10.56 points.

Table 2. Indicators of long-term adaptation of Large White sows from controlled population, n = 153

Indexes, units of measurement	Biometric indicators		
	$\overline{X} \pm S\overline{x}$	$G \pm S_G$	$Cv \pm S_{Cv}$, %
Age of life, months	50.1±1.45	18.03±1.030	35.98±2.057
Duration of breeding use, months	41.9±1.39	17.28±0.987	41.24±2.357
Index "level of adaptation", points	10.56±0.279	3.46±0.197	32.76±1.873

Taking into account the intra-breed differentiation according to the index "level of adaptation" (deviation from the average value of the index is 0.67 × σ), it was found that sows from group III according to the indicators of "farrowing" exceeded peers from group I by 5.8 farrowings (td = 16.57; P<0.001); "live piglets in total, heads" by 70.9 heads (td = 16.26; P<0.001); "multifetation, heads" by 1.0 head (td = 4.16; P (0.001); "nest weight at the time of weaning at the age of 28-32 days, kg" by 5.2 kg (td = 2.98; P<0.01); Berezovskyi index by 3.9 points (td = 2.60; P<0.01) (Table 3).

Table 3. Reproductive qualities of Large White sows of Hungarian origin of different intra-breed differentiation according to the index "level of adaptation"

Indexes, units of measurement	Biometric indicators	Gradation of the index "level of adaptation", points		
		12.97-27.20	*8.30-12.80*	*5.48-8.20*
		distribution class		
		M^+	M^0	M^-
		group		
		I	II	III
Farrowing received	*n*	*31*	*77*	*45*
	$\overline{X} \pm S\overline{x}$	4.0±0.20	6.3±0.28	9.8±0.29
	$G \pm S_G$	1.12±0.142	2.46±0.198	1.94±0.204
	$C_v \pm S_{Cv}$, %	28.00±3.557	39.04±3.148	19.79±2.087

Live piglets in total, heads	$\overline{X} \pm S\overline{x}$	42.6±2.37	71.0±3.35	113.5±3.67
	$G \pm S_G$	13.24±1.682	29.41±2.371	24.56±2.590
	$C_v \pm S_{Cv}$, %	31.10±3.951	41.43±3.341	21.64±2.282
Multifetation, heads	$\overline{X} \pm S\overline{x}$	10.6±0.19	11.2±0.11	11.6±0.16
	$G \pm S_G$	1.10±0.139	0.98±0.079	1.09±0.114
	$C_v \pm S_{Cv}$, %	10.37±1.317	8.75±0.705	9.39±0.990
Average live weight of piglets at birth, kg	$\overline{X} \pm S\overline{x}$	1.39±0.025	1.37±0.111	1.31±0.014
	$G \pm S_G$	0.14±0.017	0.98±0.079	0.08±00.008
	$C_v \pm S_{Cv}$, %	10.08±1.280	9.47±0.763	6.45±0.680
Nest weight during the weaning at the age of 28 days, kg	$\overline{X} \pm S\overline{x}$	74.7±1.44	75.9±0.91	79.9±0.98
	$G \pm S_G$	8.07±1.025	8.02±0.646	6.61±0.697
	$C_v \pm S_{Cv}$, %	10.80±1.372	10.56±0.851	8.27±0.092
Berezovskyi index, points	$\overline{X} \pm S\overline{x}$	37.98±0.595	38.31±0.253	39.93±1.40
	$G \pm S_G$	3.31±0.420	2.22±0.179	9.43±0.994
	$Cv \pm S_{Cv}$,%	8.73±1.109	5.80±0.467	23.62±2.491
Livability of piglets at the age of 28-32 days, %	$\overline{X} \pm S\overline{x}$	94.4±1.89	91.2±0.65	90.1±0.86

The coefficient of variability of traits that characterize the level of long-term adaptation and reproductive qualities of sows from experimental groups ranges from 6.45 (class of distribution of sows according to the index "level of adaptation" is M-, indicator is "live weight of piglets at birth, kg") to 41.43% (class of distribution of sows according to the index "level of adaptation" is M0, indicator is "live piglets in total, heads").

The research results of long-term adaptation and reproductive qualities of sows of different management value are shown in Table 4.

Table 4. Reproductive qualities of sows of large white breed of Hungarian origin of different management value

Indexes, units of measurement	Biometric indicators	management value		
		high	medium	low
		group		
		I	II	III
Farrowing received	*n*	*126*	*25*	*2*
	$\overline{X} \pm S\overline{x}$	7.8±0.25	3.4±0.09	2.0
	$G \pm S_G$	2.87±0.180	0.50±0.068	-
	$Cv \pm S_{Cv}$,%	36.79±2.318	14.70±2.00	-
Live piglets in total, heads	$\overline{X} \pm S\overline{x}$	87.3±2.91	33.5±0.98	18.0
	$G \pm S_G$	32.70±2.060	5.12±0.697	-
	$Cv \pm S_{Cv}$,%	37.45±2.359	15.28±2.081	-
Multifetation, heads	$\overline{X} \pm S\overline{x}$	11.2±0.08	9.8±0.15	9.0
	$G \pm S_G$	1.00±0.063	0.80±0.108	-
	$Cv \pm S_{Cv}$,%	8.92±0.562	8.16±1.111	-
Average live weight of piglets at birth, kg	$\overline{X} \pm S\overline{x}$	1.32±0.08	1.41±0.18	1.45
	$G \pm S_G$	0.09±0.005	0.09±0.001	-
	$Cv \pm S_{Cv}$,%	6.81±0.429	6.96±0.948	-
Nest weight during the weaning at the age of 28 days, kg	$\overline{X} \pm S\overline{x}$	78.7±1.01	74.9±1.32	68.2
	$G \pm S_G$	11.40±0.718	6.85±0.933	-
	$Cv \pm S_{Cv}$,%	14.48±0.912	9.14±1.245	-

Berezovskyi index, points	$\overline{X} \pm S\overline{x}$	39.04±0.538	37.19±0.334	34.14
	$G \pm S_G$	6.03±0.379	1.74±0.237	-
	$Cv \pm S_{Cv}$,%	15.44±0.972	4.67±0.636	-
Livability of piglets at the age of 28-32 days, %	$\overline{X} \pm S\overline{x}$	91.3±0.64	94.2±1.11	100.0

Studies have shown that the number of sows from the category "high management value" in the controlled population is 82.3%, from the category of "low management value" is 1.31%.
The difference between the animals from these groups in terms of "farrowing" is equal to 5.8 farrowings, in "live piglets total, heads" is 69.3 heads, in "multiplicity, heads" is 2.2 heads, in "nest weight at the time of weaning at the age of 28-32 days" is 10.5 kg, in Berezovskyi index is 4.90 points.
It was established that sows from the category "high management value" exceeded peers from the category "medium management value" in terms of "farrowing" by 4.4 farrowings (td = 16.60, P<0.001); "live piglets in total, heads" by 53.8 heads (td = 17.52, P<0.001); "multiplicity, heads" by 1.4 heads (td = 8.23, P<0,001); "nest weight at the time of weaning at the age of 28-32 days" by 3.8 kg (td = 2.28, P<0.05), Berezovskyi index by 1.85 points (td = 2.93, P<0.01)
The maximum rates of survival of piglets before weaning at the age of 28-32 days were found in group of sows where the index "level of adaptation" ranges from 12.97 to 27.20 points (94.4%), and in the category of animals of "low management value" it is 100.0%.
The results of the calculation of the pairwise correlation coefficient between the index "level of adaptation" and indicators of reproductive qualities of sows are shown in Table 5.
It was established that the coefficient of pair correlation between the traits that characterize the level of adaptation of sows and indicators of their reproductive qualities ranges from -0.670 (tr = 15.03) to +0.257 (tr = 3.40).

Table 5. Pairwise correlation coefficients between the index "level of adaptation", age of life and breeding use and sows' reproductive performance

Indicator (attribute)		Biometric indicators	
x	*y*	r±Sr	tr
Index "level of adaptation", points	1	–0.420±0.0667***	6.30
	2	–0.588±0.0529***	11.11
	3	–0.670±0.0446***	15.03
	4	–0.667±0.0449***	14.85
	5	–0.222±0.0769**	2.89
	6	+0.257±0.0755***	3.40
	7	+0.043±0.0808	0.53
	8	+0.142±0.0793	1.79

Note: *1 – age of life, months; 2 – duration of breeding use of sows, months; 3 – farrowing received; 4 – live piglets in total, heads; 5 – multifetation, heads; 6 – live weight of piglets at birth, kg; 7 – nest weight during the weaning at the age of 28-32 days, kg; 8 – livability of piglets at the age of 28-32 days, %; *** - P<0.001*

Significant correlation coefficients were established by the following pairs of features: index "level of adaptation" × age of life (r = -0.420, tr = 6.30), index "level of adaptation" × duration of breeding use (r = -0.588, tr = 11.11), index "level of adaptation" × farrowing received (r = -0.670, tr = 15.03), index "level of adaptation" × live piglets in total (r = 0.667, tr = 14.85), index "level of adaptation" × multifetation (r = -0.222, tr = 2.89), index "level of adaptation" × live weight of piglets at birth (r = +0.257, tr = 3.40).
The calculation of the economic efficiency of the research results shows that the maximum increase in additional products was obtained from sows which index "level of adaptation" ranges from 5.48 to 8.20 points (+4.99%), as well as from animals of "high management value" - (+3.41%), respectively (Table 6).

Table 6. Economic efficiency of research results

Group	n	nest weight during the weaning at the age of 28-32 days, kg	Increase in additional products, %	The cost of additional products UAH/heads/farrowing * US dollar/head/farrowing
intra-breed differentiation according to the index "level of adaptation"				
Total sample	153	76.1±0.86	-	-
I	31	74.7±1.44	-1.83	-49.61 / -1.50
II	77	75.9±0.91	-0.26	-7.04 / - 0.21
III	45	79.9±0.98	+4.99	+135.28 / +4.11
intra-breed differentiation by management value				
III	2	68.2	-10.38	-281.40 / -8.55
II	25	74.9±1.32	-1.57	-42.56 / -1.29
I	126	78.7±1.01	+3.41	+92.44 / +2.81

***Note:** * - the price of selling young pigs to processing enterprises of the region at the time of the experimental part of the study was 47.5 UAH /kg, or $ 1.44*

The cost of additional products received from one sow of these groups is +135.28 and +92.44 hryvnias or +4.11 and +2.81 US dollars.

CONCLUSIONS

1. It is established that Large White sows of Hungarian origin are characterized by high rates of long-term adaptation, management value and reproductive qualities. Thus, their age of life is 44.1 ± 1.97 months (Cv=35.27%), the duration of breeding use is 32.8 ± 1.95 months (Cv=46.91%), the index "level of adaptation" varies in the range from 5.48 to 27.20 points. According to the indicators of reproductive qualities ("multifetation, heads"; "weight of the nest at the time of weaning, kg"), 82.28% of sows belong to class I and elite class, 14.51% to class II, 3.21% to non-class animals.
2. Taking into account intra-breed differentiation according to the index "level of adaptation", a significant difference between groups of sows of class M + and M- was found in the following indicators: "farrowing received", "live piglets total, heads", " multifetation, heads" and "nest weight at the time of weaning at the age of 28-32 days, kg". The indicator "livability of piglets before weaning at the age of 28-32 days, %" in the experimental groups of sows ranges from 90.1 to 94.4%.
3. Sows from the category "high management value" exceeded peers from the category "low management value" in terms of "farrowing received", "live piglets in total, heads", "multifetation, heads", "nest weight at the time of weaning aged 28-32 days, kg" by 46.67% on average. The indicator "livability of piglets before weaning at the age of 28-32 days, %" in groups of sows of different management value ranges from 91.3 to 100.0%.
4. Coefficient of pair correlation between traits that characterize the level of adaptation of sows and indicators of their reproductive qualities ranges from -0.670 (tr = 15.03) to +0.257 (tr = 3.40).
5. The maximum increase in additional products was obtained from sows which index "level of adaptation" ranges from 5.48 to 8.20 points (+4.99%), as well as from animals of the category "high management value" (+3.41%), respectively. These indicators are proposed to be used as criteria for selection of highly productive animals in the controlled population.

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