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Operating value and economic efficiency of Large White breed sows

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The article deals with the reproductive qualities of Large White breed sows of Hungarian origin and their operational value. We also determined they economic efficiency. The experimental part of the research was conducted in agricultural formations of Dnipro region (AALLC "Druzhba-Kaznachejivka", Ltd. "Vidrodzhennja") and livestock laboratories of the State establishment Institute of Grain Crops NAAS. Evaluation of sows on the main indicators of the level of adaptation and reproductive qualities was performed taking into account the following quantitative characteristics: life expectancy, months, duration of breeding use, farrowing was obtained, total piglets were obtained, heads, live piglets were obtained, heads, fertility of heads, nest masst at the time of weaning at the age of 28 days (kg), preservation (%), duration of between farrowing period, days, number of unproductive days per farrowing. It is defined that sows of Large White breed of the controlled herd on the main indicators of reproductive qualities (fertility, head; nest mass at the time of weaning at the age of 28 days, kg) meet the minimum requirements of class I and elite class. A significant difference between the groups of animals of the categories "high operational value" and "low operational value" was defined by indicators "life expectancy, months" (29.9 months, td = 13.71), "duration of breeding use, months" (29.6 months, td = 14.50), "farrowings were obtained" (5.7 farrowings, td = 14.50), "total piglets were obtained, heads" (70.5, heads, td = 13.85), "obtained live piglets, heads" (67.7 heads, td = 20.83), "fertility, heads " (3.3 heads, td = 10.31), nest mass at the time of weaning at the age of 28 days (6.5 kg, td = 2.55). Coefficients of phenotypic consolidation of signs of reproductive qualities in sows of different operational value ranged from -0.785 to +0.856. The maximum supplement in additional products on the indicator "nest mass at the time of weaning at the age of 28 days, kg" was obtained from sows of the category "high operational value" - 6.03%.
Keywords: sow, breed, reproductive qualities, life expectancy, operational value, phenotypic consolidation coefficient, economic efficiency, variability.

Introduction

The experience of specialists of agricultural formations, as well as researches of domestic and foreign scientists testify that the current issues of development of the pig industry, along with improving the conditions of feeding and keeping animals of different production groups, there is the introduction of objective methods for assessing the breeding value of repair young stock, sows and breeding boars of the main herd (DNA markers, BLUP method, evaluative and selective indices), selection of highly productive animals and their intensive use (Mikhaylova, 2017; Kabanov, 2009; Voloshchuk, 2014; Berezovsky & Vashchenko, 2015; Hryshyna & Fesenko, 2015; Rybalko, 2015; Gutyj et al., 2017; Kozyr et al., 2019; Martyshuk et al., 2020; Khalak et al., 2020). In connection with the intensive import of pigs of foreign selection to Ukraine, important factors in the formation of a highly productive herd of pigs are the research of the level of their adaptation and operational value. This is confirmed by scientific developments of domestic and foreign scientists (Bazhov & Komlatskiy, 1989; Herasymov et al., 2003; Kodak, 2010; Usenko et al., 2019).

The purpose of the work is to investigate the reproductive qualities of sows of Large White breed of different operational value, to calculate the coefficients of phenotypic consolidation of this group of signs and the economic efficiency of research results. To achieve this goal, the following tasks were provided:

- on the basis of data of primary zootechnical documentation and results of own researches to give the characteristic of indicators of reproductive qualities of sows of Large White breed of the controlled herd;
- to determine the operational value of sows;
- to calculate the coefficients of phenotypic consolidation of signs of reproductive qualities of sows of different operational value and economic efficiency of research results.

Material and Methods

The research was conducted in terms of breeding sires for breeding Large White pigs AALLC "Druzhba-Kaznachejivka" Dnipro region and the laboratory of animal husbandry of the State establishment Institute of Grain Crops NAAS.

The evaluation of sows of Large White breed on the main indicators of the level of adaptation and reproductive qualities was carried out taking into account the following quantitative characteristics: life expectancy, months, duration of breeding use, farrowings were obtained, total piglets were obtained, heads, live piglets were obtained, heads, fertility, heads, nest mass at the time of weaning at the age of 28 days (kg), preservation (%), duration of between farrowing period, days, number of unproductive days per farrowing.

The operational value of sows of Large White breed of the controlled herd was determined by the method (Koryazhnov, 1985) (Table 1).

Table 1. Rating scale of the operational value of sows

The level of operational value	Operating value per farrowed sow		Operating value per inseminated sow	
	E_1 (total piglets)	E_1 (including viable)	E_2 (total piglets)	E_2 (including viable)
Low	≤ 25	≤ 20	≤ 25	≤15
Average	26-40	21-30	21-44	16-34
High	≥ 50	≥ 40	≥ 45	≥ 35

Selection index of sow reproductive qualities (SIRQS)(1), coefficients of phenotypic consolidation of quantitative signs of sows (K_1, K_2) (2, 3) and economic efficiency of research results (4) were calculated by the formulas:

$$SIRQS = 6 \times X_1 + 9.34 \times (X_2/X_3) \qquad (1)$$

where: SIRQS – selection index of reproductive qualities of sows, score, X_1 – fertility, heads.; X_2 – nest mass of piglets at weaning, kg; X_3 - age at the time of weaning, days (Tserenyuk et al., 2010);

$$K_1 = 1 - \frac{\sigma_2}{\sigma_3} \qquad (2)$$

$$K_2 = 1 - \frac{Cv_2}{Cv_3} \qquad (3)$$

where: σ_2 and c_{v2} – an average quadratic deviation and coefficient of variability of signs in the group, σ_3 and c_{v3} – an average quadratic deviation and coefficient of variability in animals of the general population (Polupan, 1996);

$$E = PP \times \frac{AAP \times AA}{100} \times CC \times NA \qquad (4)$$

where: E – cost of additional products, UAH; PP - purchase price per unit of output, in accordance with existing prices operating in Ukraine; AAP - average productivity of animals; AA – the average allowance of the main product (%), which is expressed as a percentage per 1 head when using a new and improved selection achievement compared to the productivity of animals of basic use; CC – constant coefficient of reduction of the result, which is associated with additional costs for profitable products (0.75); NA – the number of livestock of new or improved breeding achievement, heads.

Biometric processing of the obtained research results was performed according to the method (Lakin, 1990).

Results and discussion

It is established that the life expectancy of sows of the main herd is 43.9±1.95 мic. (lim = 21.7-87.0; Cv = 35.34%), duration of breeding use –32.6±1.92 months (lim = 9.6-71.9; Cv = 46.89%), farrowings were obtained – 6.0±0.35 (lim = 2-12; Cv = 47.18%), piglets of all – 65.5±4.35 heads (lim = 8-145 heads; Cv = 52.79%), got live piglets – 62.2±4.12 heads (lim = 7-135 heads; Cv = 53.53%), fertility – 10.1±0.20 heads (lim = 3-13 heads; Cv=15.90%), nest mass at the time of weaning at the age of 28 days – 77.0±1.00 kg. (lim=54,1-95,1 kg; Cv = 10.37%), preservation – 95.0±0.75% (lim = 79-100%), duration between the farrowing period – 175.5±3.92 days (lim = 147-279 days; Cv = 17.72%), the number of unproductive days per farrowing – 27.0±2.87 days (lim = 3-98 days; Cv = 84.47%). Breeding index of reproductive qualities of sows (SIRQS) ranges from 43.46 to 101.55 points.

The number of sows from which 84-135 live piglets were obtained during the breeding period is 29.04%, 42-81 heads. - 43.54%, 7-39 heads. - 27.42%.

The levels of adaptation and reproductive qualities of various operational value are given in Table 2.

Table 2. Indicators of life expectancy, breeding use, level of adaptation and reproductive qualities of sows of different operational value

Indicators, units of measurement	Biometric indicator	Operational value		
		high	average	low
	n	37	19	7
Life expectancy, months	$\overline{X} \pm S\overline{x}$	53.9±1.97	31.8±1.17	24.0±0.94
	σ±Sσ	12.01±1.396	5.11±0.829	2,49±0,665
	Cv±S$_{Cv}$,%	22.28±2.590	16.07±2.608	10.37±2.772
Duration of breeding use, months	$\overline{X} \pm S\overline{x}$	42.7±1.92	20.3±0.92	13.1±0.70
	σ±Sσ	11.69±1.359	4.02±0.652	1.86±0.497
	Cv±S$_{Cv}$,%	27.37±3.182	19.80±3.214	14.19±3.794
Obtained farrowings	$\overline{X} \pm S\overline{x}$	7.9±0.34	3.7±0.18	2,2±0,18
	σ±Sσ	2.09±0.243	0.80±0.129	0.48±0.128
	Cv±S$_{Cv}$,%	26.45±3.086	21.62±3.509	21.81±5.831
Obtained total piglets, heads	$\overline{X} \pm S\overline{x}$	88.2±4.30	39.0±1.55	17.7±2.73
	σ±Sσ	26.17±3.043	6.79±1.102	7.22±1.930
	Cv±S$_{Cv}$,%	29.67±3.450	17.41±2.826	40.79±10.906
Obtained live piglets, heads	$\overline{X} \pm S\overline{x}$	83.9±2.00	37.5±1.72	16.2±2.57
	σ±Sσ	24.05±2.796	7.53±1.222	6.82±1.823
	Cv±S$_{Cv}$,%	28.67±3.337	20.08±3.259	42.09±11.254
Fertility, heads	$\overline{X} \pm S\overline{x}$	10.6±0.14	10.1±0.21	7.3±0.29
	σ±Sσ	0.89±0.103	0.94±0.152	1.22±0.700
	Cv±S$_{Cv}$,%	8.39±0.975	9.30±1.509	16.71±4.467
The mass of the nest at the time of weaning at the age of 28 days, kg.	$\overline{X} \pm S\overline{x}$	77.9±1.34	75.5±1.89	71.4±2.17
	σ±Sσ	8.18±0.951	8.23±1.336	5.74±1.534
	Cv±S$_{Cv}$,%	10.50±1.220	10.90±1.769	8.03±2.147
Preservation, %	$\overline{X} \pm S\overline{x}$	94.0±1.00	95.6±1.40	99.2±0.80
	lim	75.67-101.55	73.56-99.33	43.46-84.10
Selection index of sow reproductive qualities (SIRQS), points	$\overline{X} \pm S\overline{x}$	88.95±0.985	83.13±2.011	65.12±2.256
	σ±Sσ	6,60±0,764	6.96±1.129	7.77±2.077
	Cv±S$_{Cv}$,%	7.41±0.861	8.37±1.358	11.93±3.189
Duration between the farrowing period, days	$\overline{X} \pm S\overline{x}$	167.8±3.30	175.0±5.23	217.1±22.78
	σ±Sσ	20.07±2.333	22.80±3.701	60.27±16.114
	Cv±S$_{Cv}$,%	11.96±1.390	13.02±2.113	27.76±7.422
Number of unproductive days per farrowing, days	$\overline{X} \pm S\overline{x}$	23.1±3.36	26.9±3.88	47.8±14.17
	σ±Sσ	20.47±2.380	16.92±2.746	37.49±10.024
	Cv±S$_{Cv}$,%	88.61±10.303	62.89±10.209	78.43±20.970

We found that sows of the category "high operational value" dominated their peers of the opposite class "low operational value" in terms of life expectancy by 29.9 months. (td = 13.71, P <0.001), duration of breeding use - 29.6 months (td = 14.50, P <0.001). The difference between the animals of these groups on the indicators of "farrowings were obtained" is 5.7 of farrowings (td = 14.50, P <0.001), "obtained piglets in total, heads" - 70.5 heads (td = 13.85, P <0.001), "obtained live piglets, heads" - 67.7 heads (td = 20.83, P <0.001), "fertility, heads" - 3.3 heads (td = 10.31, P <0.001), the mass of the nest at the time of weaning at the age of 28 days - 6.5 kg. (td = 2.55, P <0.05), "selection index of reproductive qualities of sows (SIRQS), points" - 23.83 points (td = 9.68, P <0.001).

Maximum indicators "preservation, %", "duration of between farrowing period, days" and "number of unproductive days per farrowing" - 99.2±0.80%, 217.1±22.78 and 27.0±2.87 days, respectively, was found in sows of the category "low operational value".

The results of the calculation of the coefficients of phenotypic consolidation of signs of reproductive qualities of sows of different operational value are given in table 3.

Table 3. Coefficients of phenotypic consolidation of signs of reproductive qualities of sows of different operational value

Indicators, units of measurement	Coefficients of phenotypic consolidation	Operational value		
		high	average	low
	n	33	104	36
obtained farrowings	K_1	0,159	0,725	0,856
	K_2	0,254	0,495	0,593
obtained piglets total, heads	K_1	0,161	0,836	0,794
	K_2	0,310	0,678	0,176
obtained live piglets, heads	K_1	0,179	0,805	0,811
	K_2	0,327	0,612	0,197
fertility, heads	K_1	0,426	0,413	-0,785
	K_2	0,456	0,394	-0,998
nest mass at the time of weaning at the age of 28 days, kg	K_1	0,047	-0,226	0,519
	K_2	0,061	-0,246	0,484

Coefficients of phenotypic consolidation of signs of reproductive qualities in sows of different operational value ranged from -0.785 to +0.856. The maximum values of the coefficient K_1 were set on the indicator "obtained farrowings" and "obtained live piglets, heads" in sows of the category "low operational value" - +0.856 and +0.811, respectively. The K_2 coefficient in sows of different operating ranges ranged from -0.998 to +0.678.
The results of the calculation of the economic efficiency of the use of sows of different operational value are shown in table 4.

Table 4. Economic efficiency of research results

Group (operational value)	n	The mass of the nest at the time of weaning at the age of 28 days, kg	Addition of additional products,%	Cost of additional products, UAH/head *
The total sample	63	73.2±1.00	-	-
low	7	71.4±2.17	-2.45	-60.93
average	19	75.5±1.89	+3.04	+75.60
high	37	77.9±1.34	+6.03	+149.96

Note: * - the selling price of young pigs on the date of the research was UAH 45.3. per 1 kg of live mass

We found that the maximum increase in additional products on the indicator "nest mass at the time of weaning at the age of 28 days, kg" was obtained from sows of the category "high operational value" - 6.03%. The cost of additional products received from animals of this group is +149.96 UAH/heads, provided that the sale price of young pigs to processing enterprises of the region at the time of the research is 45.3 UAH/kg.

Conclusions

The results of the researches show that sows of Large White breed of controlled herd for fertility (heads) and the mass of the nest at the time of weaning at the age of 28 days (kg) meet the minimum requirements of class I and elite class.
Significant difference between groups of animals of categories "high operational value" and "low operational value" is established by the following indicators: "life expectancy, months." (29.9 months, td = 13.71), "duration of breeding use, months." (29.6 months, td = 14.50), "obtained farrowings" (5.7 farrowings, td = 14.50), "total piglets were obtained, heads" (70.5 heads, td = 13.85), "obtained live piglets, heads" (67.7 heads, td=20.83), "multiplicity, heads" (3.3 goals, td=10.31), "nest mass at the time of weaning at the age of 28 days (6.5 kg, td = 2.55). Maximum indicators "preservation, %", "duration of the between farrowing period, days" and "number of days per farrowing" was found in sows of the category "low operational value".
Coefficients of phenotypic consolidation (K_1, K_2) of signs of reproductive qualities in sows of different operational value ranged from -0.785 to +0.856.
The maximum increase in additional products on the indicator "nest mass at the time of weaning at the age of 28 days, kg" was obtained from sows of the category "high operational value" - 6.03%. In the conditions of breeding plants and breeders, as well as industrial complexes, we propose to conduct a systematic assessment of sows of the main herd on the indicators of the level of adaptation and reproductive qualities. The selection of repair pigs should be carried out from animals of the category "high

operational value" and taking into account the indicators of their own productivity and reproductive qualities in accordance with the requirements of the Instructions for grading pigs.

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