

Development and reproductive qualities of sows of different breeds: innovative and traditional methods of assessment

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The article presents the results of research on indicators of own productivity of pigs and reproductive qualities of sows of different breeds and breeding value, as well as calculates the economic efficiency of research results. We studied the pigs of large white breed and Landrace breed. During our research, we evaluated the piglets live weight at birth, weight on second and fourth months, average daily and relative live weight, formation intensity, growth uniformity index and growth stress index, multiplicity, high fertility, milk yield and nest weight at the time of weaning at the age of 28-32 days. The index of alignment (homogeneity) of the sow nest by live weight of piglets at birth was calculated according to Halak (2012), selection index of sow reproductive qualities (SIRQS) – due to Tserenyuk (2014). The economic efficiency of the results was calculated according to the indicator “nest weight at weaning time, kg”. We established that the pigs of large white breed and Landrace breed belong to the first class and elite class in terms of their own productivity. Significant differences between animals of these breeds were established by live weight at birth, two-month and four-month age, average daily and relative gains in live weight during the period of control rearing. The difference between the groups in terms of integrated growth rates (formation intensity, growth stress index, growth uniformity index) ranged from 1.57 to 16.20 %. Analysis of the data shows that sows of great white breeds outnumbered peers of Landrace breed in terms of fertility by 0.5 goals, milk yield - by 3.8 kg, breeding index of reproductive qualities of sows (SIRQS) – by 1.88. Landrace sows were characterised by higher fertility rates (by 0.12 kg), nest weight at weaning at the age of 28-32 days (by 5.3 kg) and safety of piglets before weaning (by 3.5 %). The maximum increase in additional products was obtained for sows of large white breed and Landrace class M+ according to the selection index of reproductive qualities of sows (SIRQS) and these were 16.49–6.23 %, and its value is 412.22 and 166.83 UAH more in accordance.

Key words: pigs, breed, own productivity, ontogenesis, sow, reproductive qualities, nest uniformity, index, economic efficiency

Introduction

Swine breeding is an important sphere of livestock farming in Ukraine; it produces the bulk of food products of animal origin (Gutyj et al., 2017; Cherniy et al., 2018; Iesina et al., 2018; Martyschuk et al., 2019; Khalak & Gutyj, 2020; Khalak et al., 2020). The important factor in improving the efficiency of pork production is the assessment of young stock towards their productivity, and evaluation of sows reproductive qualities. Selection of highly productive animals of these sex and age groups is carried out according to the requirements of the 'Instruction on grading pigs' and on the basis of index selection methods (Voloshchuk, 2014; Esfandyari et al., 2015; Grishina & Fesenko 2015). This work involves the search for effective methods for assessing their breeding value (Balatsky et al., 2016; Berezovsky & Vashchenko, 2010; Vashchenko, 2010; Berezovsky, 2014; 2016). Our aim was to investigate the indicators of own productivity of pigs and reproductive qualities of sows of different breeds and breeding value and to calculate the economic efficiency of research results.

Materials and Methods

The study was conducted in the experimental farm and laboratory of animal husbandry and feed production of the Institute of Agriculture of the Northeast NAAS of Ukraine, 'Borisfen' Farm (Dnipropetrovsk region) and Laboratory of Animal Husbandry Research Institute of Cereals of NAAS of Ukraine. The work was performed according to the IPA NAAS № 30 "Pig breeding". Evaluation of sows and sows of large white breed and Landrace breed was carried out taking into account the following absolute and integrated indicators: live weight at birth, on second and fourth months, average daily (g) and relative (%) increase in live weight during the period of control cultivation, fertility, milk yield, nest weight at the time of weaning (28–32 days) and safety of piglets before weaning, %.

The intensity of formation (Δt), indices of uniformity (u_i), growth stress (g_i), uniformity (homogeneity) of the sow's nest by live weight of piglets at birth (4) and the selection index of reproductive qualities of the sow (SIRQS) (5) were calculated by formulas:

$$\Delta t = \frac{W_2 - W_0}{0,5 \times (W_2 + W_0)} - \frac{W_4 - W_2}{0,5 \times (W_4 + W_2)}, \quad (1)$$

$$GSI = \frac{\Delta t}{RIW} \times ADG, \quad (2)$$

$$UI = \frac{1}{1 + \Delta t} \times ADG, \quad (3)$$

ere: Δt is the intensity of formation; W_0 - W_2 - W_4 - live weight of pigs, at birth, on second and fourth months of age, kg, UI - index of uniformity of growth; GSI - growth stress index; ADG - average daily weight gain, kg; RIW - relative increase in live weight, % (Kovalenko et al., 2008).

$$IVG_0 = \frac{n}{2.5 - \left(\frac{x_{max} - x_{min}}{\bar{X}} \right)}, \quad (4)$$

where: IVG_0 - index "alignment (homogeneity) of the sow's nest by live weight of piglets at birth", points; n - sow fertility, 2.5 - the maximum live weight of one piglet at birth, kg; x_{max} - live weight of the heaviest piglet in the nest, kg; x_{min} - live weight of the smallest piglet in the nest, kg; \bar{X} - average live weight of piglets in the nest at birth (sow fertility), kg (Khalak, 2012);

$$SIRQS = 6 \times X_1 + 9.34 \times (X_2 / X_3) \quad (5)$$

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

The breeding value of sows was determined by the selection index of reproductive qualities of sows (SIRQS), the economic efficiency of research results - by "Methods for determining the economic efficiency of agricultural use of research results, new equipment, inventions, innovation proposals" (1983). Biometric processing of the obtained research results was carried out according to Lakin (1985), using the programmable module "Data Analysis" in Microsoft Excel. The data in the tables are presented like the means and standard deviations.

Results and discussion

The analysis of the obtained data shows that the pigs of Landrace breed have higher live weight than the pigs of large white breed, namely by 0.32 kg at birth ($td = 13.91$; $P < 0.001$), by 2.1 kg ($td = 9.54$; $P < 0.001$) at two months of age, and by 3.6 kg ($td = 5.71$; $P < 0.001$) at four months of age (Table 1). The difference between the groups in terms of average daily and relative weight gain for the period of control cultivation was 0.048 kg ($td = 15.00$; $P < 0.001$) and 0.80 % ($td = 5.12$; $P < 0.001$) respectively.

Table 1. Parameters of individual development (pigs of large white breed and Landrace breed, early ontogenesis)

Parameter	Breed	
	Big white (n=136)	Landrace (n=64)
Live weight at birth, kg	1.38±0.013	1.70±0.020
Live weight at 2 months, kg	19.6±0.11	21.7±0.20
Live weight at 4 months, kg	43.6±0.28	47.2±0.57
The average daily increase in live weight, kg	0.358±0.0015	0.406±0.0029
Relative increase in live weight, %	188.3±0.10	187.5±0.12
Forming intensity	0.991±0.0106	0.884±0.0095
Growth stress index	0.181±0.0014	0.216±0.0022
Growth uniformity index	0.188±0.0019	0.191±0.0018

Landrace pigs were characterized by a lower integrated indicator (intensity of formation was lower by 10.79 %), by more higher indices of growth stress (by 16.20 %) and uniformity of growth (by 1.57 %). The sows of the large white breed had more higher values than the Landrace breed in multifertility (by 0.5 pigs; $td = 2.17$; $P < 0.005$), in milk yield (by 3.8 kg; $td = 3.76$; $P < 0.01$), in SIRQS (by 1.88; $td = 1.05$; $P > 0.05$).

Landrace sows were characterized by higher fertility rates (by 0.12 kg; $td = 5.21$; $P < 0.001$), nest weight at weaning at the age of 28-35 days (by 5.3 kg; $td = 3.84$; $P < 0.001$) and by survival rate before the weaning (by 3.5 %; $td = 2.38$; $P < 0.05$).

Table 2. Parameters of sows' reproductive qualities

Parameter	Breed	
	Big white (n=138)	Landrace (n=50)
Multifertility, heads	11.1±0.14	10.6±0.19
Large-fertility, kg	1.31±0.009	1.43±0.022
Index "alignment of the sow's nest on the live weight of piglets at birth"	5.23±0.076	5.01±0.101
Milk yield, kg	51.9±0.81	48.1±0.61
The weight of the nest at weaning (28-32 days), kg	74.4±0.85	79.7±1.09
Survival rate of piglets before weaning, %	89.9±0.49	93.4±1.39
SIRQS	88.58±1.118	86.70±1.401

The analysis of individual development and reproductive qualities of sows of large white breed and Landrace breed of different breeding value are given below (Tables 3 and 4).

Table 3. Parameters of individual development and reproductive qualities for sows of large white breed of different classes according to SIRQS

Parameter	Distribution class towards the SIRQS		
	M ⁺ (n=28)	M ⁰ (n=75)	M ⁻ (n=35)
Forming intensity	0.975±0.0232	1.003±0.0147	0.976±0.0207
Growth stress index	0.186±0.0039	0.189±0.0026	0.186±0.0037
Index of uniformity of growth	0.184±0.0033	0.178±0.0018	0.183±0.0026
Multi fertility, heads	13.4±0.18	11.2±0.07	8.8±0.16
Large-fertility, kg	1.36±0.022	1.41±0.012	1.44±0.017
Index "alignment of the sow's nest on the live weight of piglets at birth"	6.32±0.110	5.33±0.051	4.12±0.088
Milk yield, kg	66.1±1.29	50.7±0.68	43.0±0.38
The weight of the nest at weaning (28-32 days), kg	89.1±1.29	73.6±0.69	64.5±0.42
Survival rate of piglets before weaning, %	86.0±1.04	83.9±0.62	86.3±1.10
SIRQS	107.18±1.384	89.43±0.536	71.88±0.968

The sows of large white breed and Landrace class M⁺ had more higher fertility by 4.4 ($td = 18.33$; $P < 0.001$) and 3.4 heads ($td = 12.63$; $P < 0.001$), more higher milk yield – by 23.1 ($td = 17.23$; $P < 0.001$) and 4.3 kg ($td = 2.59$; $P < 0.05$), nest weight at the time of weaning (28-32 days) – by 24.6 ($td = 18.22$; $P < 0.001$) and 11.8 kg ($td = 4.70$; $P < 0.001$), and higher selection index of reproductive qualities of the sow – by 35.30 ($td = 21.01$; $P < 0.001$) and 25.21 ($td = 13.48$; $P < 0.001$). According to the sow's fertility, alignment of the sow's nest by live weight of piglets at birth, and the safety of piglets before weaning, the difference in favor of animals of class M was 0.08 ($td = 2.96$; $P < 0.01$) - 0.16 kg ($td = 2.67$; $P < 0.01$), 2.2 ($td = 15.71$; $P < 0.001$) - 1.67 points ($td = 9.59$; $P < 0.001$) and 0.3 $td = 0.19$; $P > 0.05$) - 10.5 % ($td = 6.28$; $P < 0.001$).

A certain pattern of changes in the integrated growth rates (formation intensity, uniformity indices and growth stress of the pigs) has not been established. The coefficient of variability in productivity of pigs of different classes according to the BLUP index ranged from 3.10 (M-, body length) to 25.36 % (M+, thickness of fat on the buttocks). The calculating of the economic efficiency revealed the maximum increase in production was obtained from sows of large white breed and Landrace breed class M+ with SIRQS values 16.49 and 6.23 %, respectively (Table 4).

Table 4. Parameters of individual development and reproductive qualities of Landrace sows of different classes of distribution according to SIRQS values

Parameters	Distribution class towards the SIRQS		
	M ⁺ (n=13)	M ⁰ (n=25)	M ⁻ (n=12)
Forming intensity	0.896±0.0200	0.883±0.0147	0.862±0.0199
Growth stress index	0.192±0.0046	0.195±0.0026	0.186±0.0052
Index of uniformity of growth	0.212±0.0031	0.221±0.0033	0.218±0.0043
Multi fertility, heads	12.1±0.10	10.8±0.12	8.7±0.25
Large-fertility, kg	1.39±0.041	1.39±0.026	1.55±0.045
Index "alignment of the sow's nest on the live weight of piglets at birth"	5.77±0.098	5.045±0.0757	4.10±0.144
Milk yield, kg	49.5±0.81	48.7±0.82	45.2±1.46
The weight of the nest at weaning (28-32 days), kg	85.0±1.28	78.6±1.05	73.2±2.17
Survival rate of piglets before weaning,%	88.6±1.45	90.9±1.17	99.1±0.83
SIRQS	99.02±0.756	88.60±0.750	73.81±1.711

Table 5. Economic efficiency of sows of different breeding value

Group (distribution class by SIRQS index)	n	The mass of the nest at weaning (28-32 days), kg	Product growth,%	Cost of additional products, UAH / head *
<i>White big breed</i>				
Total	138	74.4±0.85	-	-
M ⁻	28	64.5±0.42	-13.30	-332.47
M ⁰	75	73.6±0.69	-1.07	-26.74
M ⁺	35	89.1±1.29	+16.49	+412.22
<i>Landrace</i>				
Total	138	79.7±1.09	-	-
M ⁻	13	73.2±2.17	-8.15	-218.25
M ⁰	25	78.6±1.05	-1.38	-36.95
M ⁺	12	85.0±1.28	+6.23	+166.83

* The retail price of young pigs on the date of the study was 44.8 UAH per 1 kg of live weight.

The cost of additional products received from one head of large white breed and landrace breed M+ is +412.22 and 166.83 UAH in accordance.

Conclusions

Pigs of large white breed and landrace breed according to indicators of own productivity belong to the first and elite class. Significant difference between the animals of these breeds was established in the live weight at birth (0.32 kg; $t_d = 13.91$; $P < 0.001$), at two 2 months of age (2.1 kg; $t_d = 9.54$; $P < 0.001$) and four months of age (3.6 kg; $t_d = 5.71$; $P < 0.001$), in average daily and relative gains in live weight during the period of control cultivation (0.048 kg; $t_d = 15.00$; $P < 0.001$ and 0, 80 %; $t_d = 5.12$; $P < 0.001$). The difference between the groups in terms of integrated growth rates (formation intensity, growth stress index, growth uniformity index) ranged from 1.57 to 16.20 %. We found that sows of large white breed had more higher parameters than those of Landrace breed in multiplicity (by 0.5 goals), in milk yield (by 3.8 kg), in SIRQS - by 1.88. Landrace sows were characterized by higher fertility rates (0.12 kg higher), nest weight at weaning period of 28-32 days (5.3 kg) and survival of piglets before weaning (3.5 %). Calculations of economic efficiency proved that sows of big white breed and breed of landrace of class M+ had the maximum increase of additional production, the SIRQS values were lower by 16.49–6.23% and these costs were 412.22 and 166.83 UAH higher.

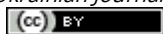
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