Porcine Research

Dependence of sows' productivity on the reason of their culling, in index selection

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Abstract. When studying the dependence of the lifelong productivity of sows on the reason of their culling in index selection, we detected no significant effect of culling due to technological and veterinary reasons on the change in the percentage of high-productive animals in the herd. Credible differences in the number of piglets born per litter among sows culled for various reasons were detected only between groups of sows culled due to age and selection (10.1% with $p < 0.01$). These differences prove the validity of the culling at the level of the estimated generation. Also the productivity of sows was evaluated in individual farrows. The peak of sows' productivity is marked at the period from the fifth to the seventh farrows. Credible differences between the sows' productivity in the first two farrows and the following ones were established.
Key Words: pig, selection, selection index, sow, culling, farrow.

Абстракт. При изучении зависимости пожизненной продуктивности свиноматок от причины их выбраковки при индексной селекции не установлено существенного влияния браковки по технологическим и ветеринарным причинам на изменение в стаде процента высокопродуктивных животных. Достоверные отличия по многоплодию маток выбракованных по различным причинам выявлены только между группами маток выбракованных по причине возраста и селекционной браковкой (10,1% при $p<0.01$). Данные различия подтверждают правильность браковки на уровне оцененного поколения. Также оценена продуктивность свиноматок по отдельным опоросам. Отмечен пик продуктивности свиноматок с пятого по седьмой опоросы. Установлены достоверные различия между продуктивностью свиноматок по первым двум и последующим опоросам.
Ключевые слова: свиньи, селекция, селекционный индекс, свиноматка, выбраковка, опорос.

Introduction. Far back as 1937 Ukrainian-American evolutionary biologist Dobzhansky (1937) suggested "that most, and possibly all, genes have manifold effects." Hazel (1943) noted that these factors make wise selection a complicated and uncertain procedure; in addition fluctuating, vague, and sometimes erroneous ideals often cause the improvement resulting from selection to be much less than could be achieved if these obstacles were overcome.

Modern breeding approaches in the pig-breeding include assessment at the level of genes and genomes, selection using different models, etc. (Balatsky et al 2018; Octura et al 2014; Liyadskiy et al 2011 and others). However, in the post-Soviet countries, the assessment of animals in breeding farms is often done on a limited number of indicators. Sometimes index selection is used, as well as selection based on individual QTL genes (Stryzhak et al 2018; Susol 2014 and others).

Modern breeding and artificial selection play critical roles in shape the genetic variation of different breeds (Yang at al 2014). Today in Ukraine, 9 different breeds are bred. Two breeds are completely lost in 2018 due to ASF. Accordingly, the remaining small herds are of particular interest. As noted by Loban (2012), the basis of pig-

breeding system in the pork production technology is the parent breeds. The overall result depends on the level of their productivity and adaptation to the harsh conditions of industrial technology. The important point is the influence of other factors which reduce the effect of directional selection.

The Welsh pig-breed is of certain interest. This breed is raised in Ukraine since 1964 (Zhukors'kyj et al 2017). To date, these herds have formed as an independent unique population (Tsereniuk 2010).

Therefore, dependence of sows' productivity on the reason of their culling in index selection of Welsh breed of pigs is of actual interest.

Material and Method

Animals. 87 sows, Welsh breed, different aged were used in the given experiment. We estimated the sows of the main herd at the official Welsh breeding farm of the Ukrainian swine population. The animals were kept in the same living, feeding and selection effects conditions. The sows were kept in group stalls (in the period of gestation) and in individual stalls (in the period of insemination, conditional gestation, farrowing and lactation) on fully or partially slotted floors. Sow feeding at all the periods was accomplished with appropriate high-grade dry compound feedstuff according to the rations for specific periods.

Laboratory investigation. The lifetime productivity of sows culled throughout 2017 for various reasons was evaluated. All culling purposes were divided into four groups. Veterinary reasons for culling (I) included all injuries that did not allow further use of sows, various non-communicable diseases, etc. Technological reasons for culling (II) were multiple returns to estrus, false estruses, lack of estrus for a long period, etc. Selection reasons for culling (III) considered animals excluded from the herd due to low values of the selection index. The fourth group (IV) consisted of animals culled due to reaching the age of five years old. During the productive period, the following indicators were evaluated for each sow: the total number of returns to estrus; the total number of small litters at birth (all farrows with less than 8 piglets at birth, in total), the total number of small litters for weaning (all farrows with less than 7 piglets for weaning), as well as the total number of normal farrows.

Breeding approaches. Selection in the herd was based on index estimation. Each sow was assessed by the SIRQS index. Evaluation data were updated after each sow's farrow (after weaning piglets). Animals with the lowest index in the technological group were culled. The evaluation was carried on after at least two farrows. The data on small litters at birth and small litters for weaning farrows were not included in the index score. The sows with two small litters at birth or small litters for weaning farrows were culled for technological reasons.

Statistical analysis. General principles and approaches for evaluating various groups complied with the requirements accepted in Ukraine, Ovsyannikov (1976). Recalculation of data on the number of piglets born per litter at weaning was carried out according to Melnyk et al (2003). All the data obtained were statistically processed using the computer program Excel in accordance with the methods developed by Plohinskii (1969).

Results and Discussion. Evaluation of productive farrows considering lifelong productivity indicates significant differences in the groups of sows culled for various reasons (Figure 1). The largest percentage of productive farrows for the lifelong period was found in sows culled due to reaching the critical age. This is logical, since these animals are culled from the herd not because of their low productivity. Consequently, the animals remaining in the herd must comply with selection requirements and show high productivity and be suitable for prolonged use.

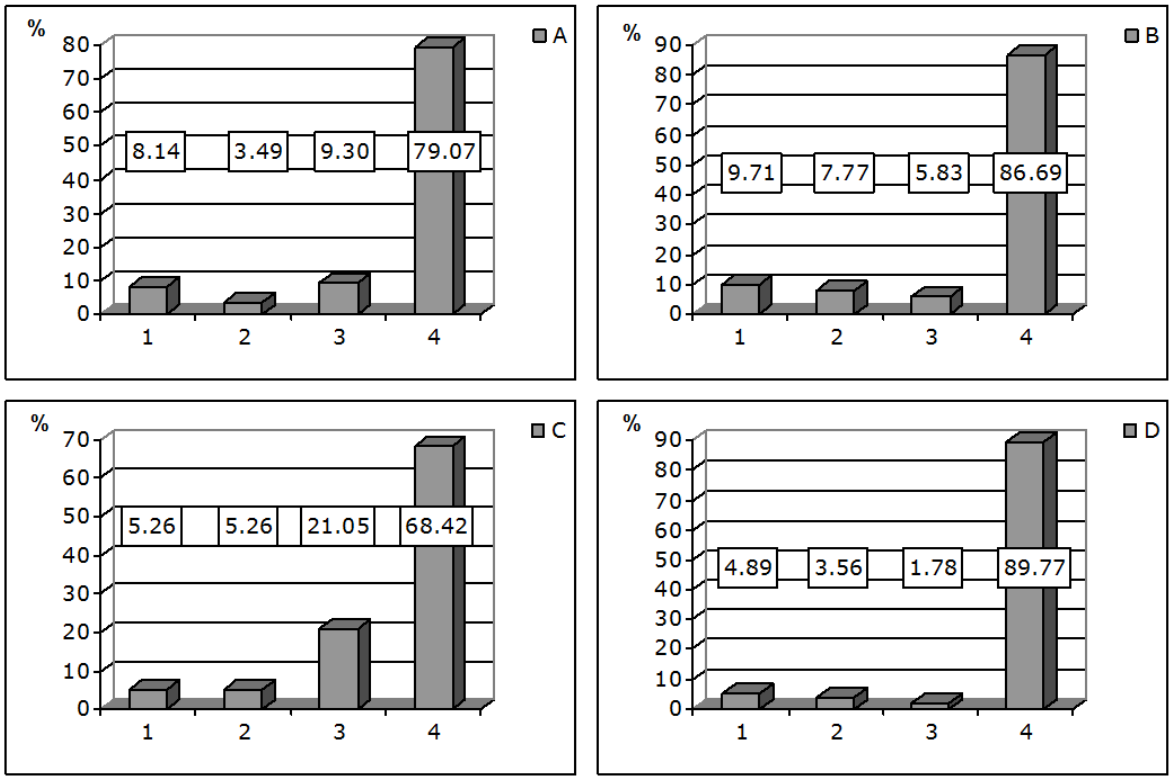

Figure 1. The percentage of productive farrows and pathologies of reproduction for sows, culled for various reasons. The lifetime productivity of the sows is given. A - the sows culled for veterinary reasons, B - the sows culled for technological reasons, C - the sows culled for selection reasons, D - the sows culled for the reason of age. 1 - the total number of returns to estrus for the productive period (%); 2 - the total number of small litters at birth for the productive period (%); 3 - the total number of small litters for weaning for the productive period (%); 4 - the total number of normal farrows for the productive period.

The smallest percentage of productive farrows for the life period was detected in the sows culled for selection reasons. It also corresponds to the fact that such animals are culled from the herd due to their low productivity. The groups of sows culled for veterinary and technological reasons had intermediate values. At the same time, it is necessary to note a high percentage of returns to estrus among the sows culled for technological and veterinary reasons compared with the sows culled for selection reasons and age. Also in relation to the other groups, the sows culled for technological reasons had the largest percentage of small litters at birth. Regarding small litters for weaning, the greatest differences were seen between the sows culled due to their age and for selection reasons. The latter had 19.27% more small litters for weaning compared to the aged animals. This may be due to both the fact that most of the small litters for weaning are found among the first farrows, and also individual characteristics of the sows.

The next stage of the study was determining the lifetime productivity of the sows. As it is apparent from the Table 1, the largest number of farrows occurred in the sows culled by age, the lowest - in the sows culled for selection reasons, respectively. The groups of sows culled for veterinary and technological reasons showed medium values, however, they were closer to the sows culled for selection reasons. This may indicate that the sows culled for selection and technological reasons are also culled mainly in the first farrow. A similar pattern was observed for the total number of piglets at birth. The differences in the percent of weaned piglets between different groups of sows were not significant. Also, there were no significant differences between different groups of sows, culled for various reasons and by the number of piglets born per litter at weaning. The difference between the most contrasting groups was at the level of 1.88%. At the same time, in the presence of high levels of significant differences in the number of farrows

between all other reasons for culling due and culling due to age, significant differences in the numbers of piglets born per litter occurred only between the groups of sows culled due to age and selection culling (10.1% with $p<0.01$).

Table 1

Lifetime productivity of sows culled for various reasons

Culling reason	*Total number of farrows*	*Number of piglets at birth (individuals)*	*Percent of weaned piglets (%)*	*Piglets born per litter (kg)*
Veterinary	4.10±0.447***	13.36±0.391	89.56	184.77±2.294
Technological	5.15±0.483***	13.76±0.452	88.70	185.16±1.716
Selection	3.80±0.427***	12.67±0.291**	88.85	181.75±2.245
Age	8.65±0.260	13.95±0.278	88.50	184.11±1.495
All reasons	5.63±0.293	13.47±0.181	88.88	183.97±0.956

** significant compared with age ($p<0.01$), *** significant compared with age ($p<0.1$).

Also, a selection index was calculated individually for each sow. As can be seen in Figure 2, the highest values of the selection index were obtained for the sows culled due to age, the lowest – for the sows which were culled from the herd due to the lowest values of the index. The intermediate index values were obtained for the sows culled for veterinary and technological reasons. At the same time, the sows culled for technological reasons had high index values.

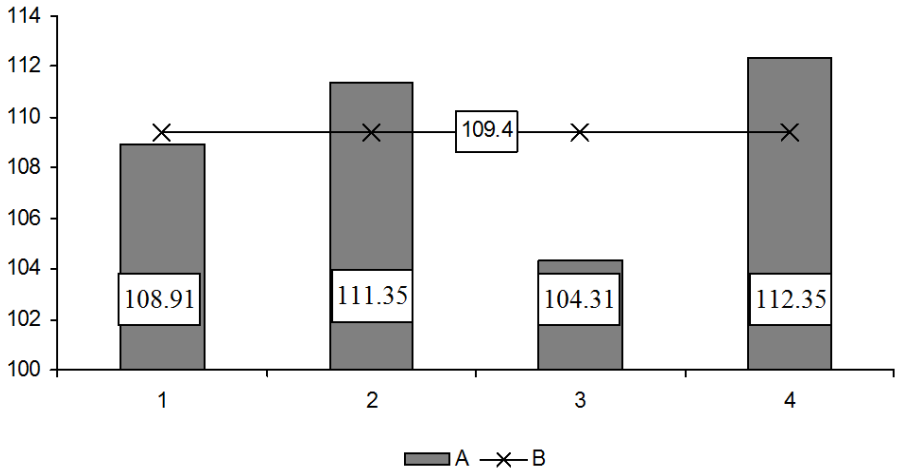

Figure 2. The values of the selection index for different groups of the culled sows. The calculation of the index for lifetime productivity of the sows. A – the sows culled for different reasons, B - all the culled sows. 1 - the sows culled for veterinary reasons, 2 - the sows culled for technological reasons, 3 - the sows culled for selection reasons, 4 - the sows culled for the reason of age.

The lifetime productivity of the sows was also evaluated for individual farrows. As it is apparent from the Table 2, the lowest values of the number of piglets born per litter were recorded for the first two farrows. The obtained differences were significant for all evaluated farrows with different levels of veracity. At the same time, the minimum values were obtained on the indicator of the number of piglets born per litter at weaning for the last farrows. Regarding the percent of weaned piglets before weaning, the best results were obtained in the first farrows of sows. The most contrasting farrow concerning the number of piglets born per litter was with 2.87 individuals, with 6.04 kg per litter at weaning, respectively.

Table 2

Lifetime productivity of sows culled at various farrows

Farrow	*Total number of piglets at birth (individuals)*	*Percent of weaned piglets (%)*	*Piglets born per litter (kg)*
1	11.99±0.221*[b]	93.30	183.44±1.931
2	12.68±0.256 *[a]	90.09	185.98±1.768
3	14.10±0.303 ***[a], ***[b]	86.20	187.36±1.743
4	14.07±0.314 ***[a], ***[b]	88.52	187.30±2.093
5	14.86±0.308 ***[a], ***[b]	87.08	183.53±1.913
6	14.72±0.472 ***[a], ***[b]	87.69	183.20±2.157
7	14.66±0.463 ***[a], ***[b]	88.59	183.39±2.087
8	14.48±0.418 ***[a], ***[b]	86.49	183.06±1.789
9	14.08±0.597 **[a], *[b]	84.51	181.32±2.285
10	14.63±0.663 ***[a], **[b]	86.75	182.26±2.514

*[a] significant compared with first farrow ($p<0.05$), **[a] significant compared with first farrow ($p<0.01$), ***[a] significant compared with first farrow ($p<0.1$); *[b] significant compared with second farrow ($p<0.05$), **[b] significant compared with second farrow ($p<0.01$), ***[b] significant compared with second farrow ($p<0.1$).

More clearly, the differences in the productive level of the sows in the farrows are presented in calculation of the selection index (Figure 3).

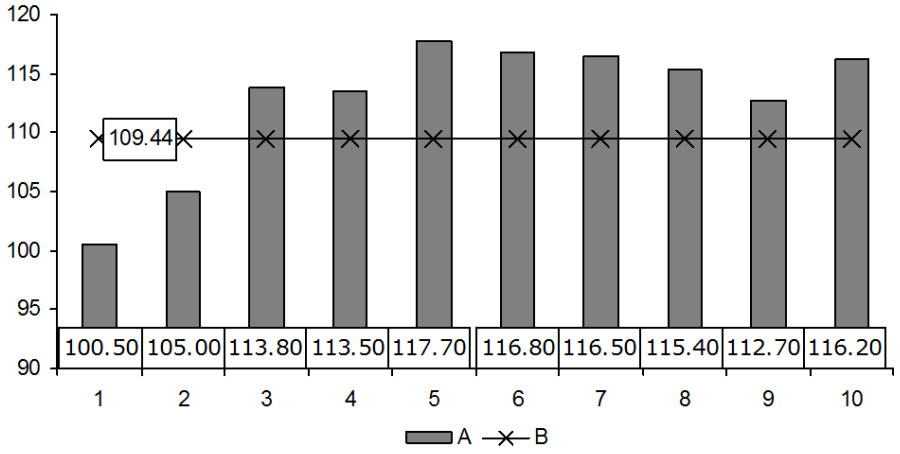

Figure 3. The values of the selection index for farrows of the culled sows. A - index values for farrows, B - average index value for all farrows. 1-10 - sequential farrows.

As can be seen from the calculation of the index, the peak of the sows' productivity occurred in the period from the fifth to the seventh farrows. The minimum values were observed in the first two farrows. After the seventh farrow, the subsequent ones (with the exception of the last one) showed a gradual decrease in the productivity of sows, which is also consistent with the data of Lugovoy & Likhach 2015; Anisimova & Ivanova 2016; Koketsu & Dial 1997; Serenius & Stalder 2007 and others. As De Vries (1989) indicated, relative values of traits might change in future and therefore a reduction of the absolute values is more likely than an increase.

Conclusions. In our researches, no significant effect of culling due to technological and veterinary reasons on the change in percentage of highly-productive animals in the herd has been established. In case where we find high levels of significant differences in the

number of farrows between all other culling reasons and culling due to age, significant differences in the numbers of piglets born per litter were detected only between the groups of the sows culled due to age and selection culling (10.1% at $p<0.01$). These differences confirm the validity of the culling at the level of the estimated generation. In further evaluation, we should also take into account the fact of significant differences between the productive qualities of sows at individual farrows, especially at the initial stage and further productivity.

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