Dependence of sows` phenotypic consolidation of productivity on the reason of their culling due in index selection

[1]Oleksandr Tsereniuk, [2]Ruslan Susol, [3]Oleksandr Bordun, [4]Andriy Paliy, [5]Oksana Shkromada, [1]Oleksandr Akimov, [1]Marina Tsereniuk

[1] Laboratory of Small Animal Husbandry and Horsbreeding, Institute of Animal science of UAAS, Kharkiv, Ukraine; [2] Department of Production and Processing Technology of Livestock Products, Odessa State Agrarian University, Odessa, Ukraine; [3] Laboratory of Livestock and Feed Production, North-Eastern UAAS Institute of Agriculture, Sad, Ukraine; [4] Educational-Scientific Institute of Technical Service, Kharkiv National Technical University of Agriculture named after Petro Vasylenko, Kharkiv, Ukraine; [5] Faculty of Veterinary Medicine, Sumy National Agrarian University Sumy, Ukraine. Corresponding author: O. Tsereniuk, tserenyuk@gmail.com

Abstract. Studies on determining the differences between sows, which were culled for various reasons, have been continued. The phenotypic consolidation coefficients are estimated on the main indicators of sow productivity (based on the standard deviation and the coefficient of variability). Different levels of consolidation have been determined for the groups of sows, culled for various reasons. Differences were found during the calculation of the consolidation of indicators for different mechanisms. In most cases, the highest values of the phenotypic consolidation coefficients were obtained from the index of the total number of farrows. According to the rest of the estimated values for different groups of culled sows, no specific dependency was found. Considerable differences between the groups according to the estimated indicators of the phenotypic consolidation coefficients were revealed when estimating the phenotypic consolidation coefficients based on the variability coefficients.
Key Words: pig, selection, selection index, *Sus scrofa domesticus*, culling due, farrow.

Абстракт. Продолжены исследования по установлению различий между свиноматками, которые были выбракованы по разным причинам. Оценены коэффиценты фенотипической консолидации по основным показателям продуктивности свиноматок (на основе среднеквадратического отклонения и коэффициента изменчивости). Установлен разный уровень консолидированости по группам свиноматок, выбракованным по разным причинам. Выявлены различия при расчете консолидированности показателей при разных механизмах. В большинстве случаев наибольшие значения коэффициентов фенотипической консолидации получены по показателю общего количества опоросов. По остальным оцененным показателям по разным группам выбракованных свиноматок четких зависимостей не выявлено. Большие различия выявлены между группами по оцененным показателям коэффициентов фенотипической консолидации при их оценке на основе коэффициентов изменчивости.
Ключевые слова: свиньи, селекция, селекционный индекс, свиноматка, выбраковка, опорос.

Introduction. 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). Gradually, the number of genes of quantitative trait (QTL) is expanding. The populations are successfully evaluated and improved by the genes: RYR-1, ESR, PRLR, MC4R, etc. However, in the post-Soviet countries, the assessment of animals in breeding farms is often done on a limited number of indicators indications. Sometimes index selection is used, as well as selection based on individual QTL genes (Stryzhak et al 2018; Susol 2014 and others). New indices are being developed, the BLUP assessment is introduced, which leads to a gradual

modification of the structural composition of populations both at the linear level and in representation of more highly productive animals in the herds.

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 pig breeds are bred. Two breeds were completely lost in 2018 due to African swine fewer (ASF). Accordingly, the remaining small herds are of particular interest. 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 et al 2018).

Also, the important direction is the adaptability of animals at the level of herds and populations to certain feeding conditions, keeping and suitability for industrial technology. To a certain extent, consolidation (including the estimated phenotypic consolidation and calculated coefficients) is responsible for this. Thus, the consolidation and typification of herds makes it possible to create and use highly effective technologies, since the animals show the standard of necessary criteria and their stability (Ivanov 2016). Of particular importance it is in dealing with the reproductive qualities of sows, as this group in particular is characterized by a significant reaction to the influence of paratypic features (Timofienko 2015).

Therefore, dependence of sows` phenotypic consolidation productivity on the reason of their culling due in index selection of Welsh breed of pigs is an actual concern.

The purpose of our research was to identify differences in dependence of sows` phenotypic consolidation productivity on the reason of their culling due in index selection of Welsh breed of pigs.

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 suction) 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 due (I) included all injuries that did not allow further use of sows, various non-communicable diseases, etc. Technological reasons for culling due (II) were multiple returns to estrus, false estruses, lack of estrus for a long period, etc. Selection reasons for culling due (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. On the basis of the absolute values obtained, the coefficients of phenotypic consolidation were calculated using Polupan's (2002) method. The coefficients were determined on the basis of standard deviation (K_1) and the coefficient of variability (K_2) in relation to the average data for all culled animals (K_c).

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. In the previous phase, we analyzed the dependence of lifetime productivity of the sows on the reason of their culling due at index selection (Tsereniuk et al 2018). We detected no significant effect of culling for 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 culling due (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 was marked at the period from the fifth to the seventh farrows.

Also, credible differences between the sows' productivity in the first two farrows and the following ones were established.

The estimation of the phenotypic consolidation coefficients (based on the standard deviation) (Figure 1) indicates an adequate level of consolidation of the sows, culled for various reasons, at the indicator of total number of farrows.
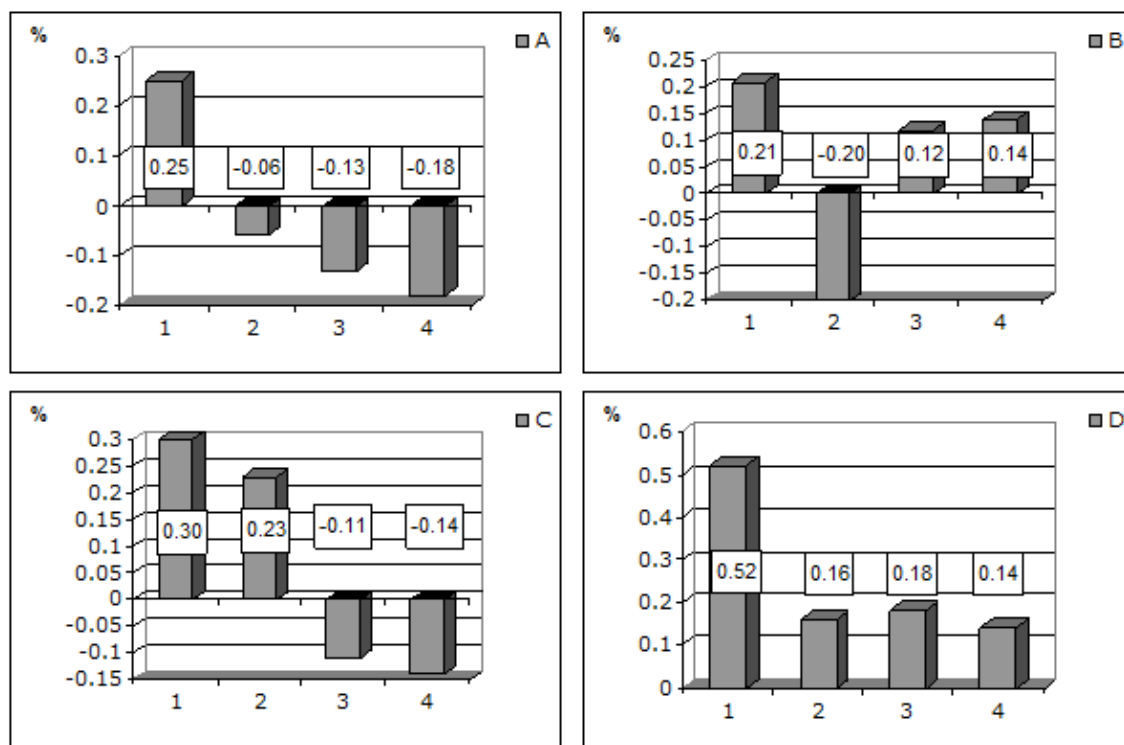

Figure 1. The coefficient of phenotypic consolidation (based on standard deviation) of the productivity indicators for sows, culled for various reasons. The lifetime productivity of the sows is given. A - the sows culled for veterinary reasons, B - the sows culled for technological reasons, C - the sows culled for selection reasons, D - the sows culled for the reason of age. 1 - total number of farrows; 2 - total number of piglets at birth (individuals); 3 - percent of weaned piglets (%); 4 - weights at weaning per litter (kg).

Variations in the groups of sows, culled for various reasons, ranged from 0.21 to 0.52 points. However, at the total number of piglets at birth (individuals), the differences between various groups were already significant. The sows culled for veterinary (A) and technological (B) reasons were characterized by unconsolidated values (K_1 from -0.06 to -0.20). At the same time, this indicator among the sows, culled for selection (C) reasons or by age (D), was more consolidated (K_1 from 0.23 to 0.16). According to the final indices of maternal productivity, the sows culled by technological (B) or age (D) reasons were more consolidated. It should also be noted that the level of phenotypic consolidation coefficients at the percent of weaned piglets and weights per weaning per litter was almost the same in each group of sows culled for various reasons.

The estimation of the phenotypic consolidation coefficients (based on the variability coefficient) shows rather different results (Figure 2).
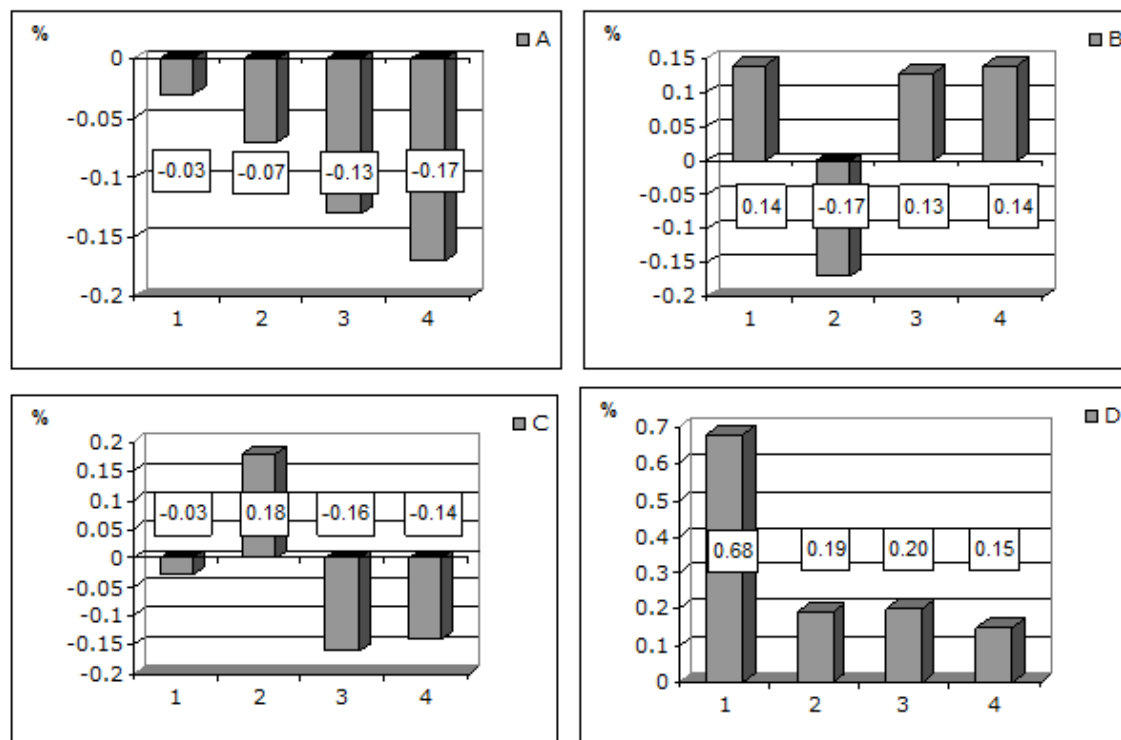

Figure 2. The phenotypic consolidation coefficient (based on the variability coefficient) of the productivity indicators for sows, culled for various reasons. The lifetime productivity of the sows is given. A - the sows culled for veterinary reasons, B - the sows culled for technological reasons, C - the sows culled for selection reasons, D - the sows culled for the reason of age. 1 - the total number of farrows; 2 - the total number of piglets at birth (individuals); 3 - percent of weaned piglets (%); 4 - weights at weaning per litter (kg).

The sows culled for veterinary (A) and breeding (C) reasons were the least consolidated by the total number of farrows indicator. At the same time, the sows, culled by age (D), were considerably consolidated by this indicator. According to the remaining indicators, the calculation of the phenotypic consolidation coefficients based on the variability coefficient corresponded to a greater extent to the similar coefficient calculated on the basis of the standard deviation.

Regarding the differences between the groups according to the estimated indicators of the phenotypic consolidation coefficients, at the calculation on the basis of the standard deviation, the variation of indicators were within the range of 0.31-0.43 points. At calculation based on the coefficient of variability, the differences were more significant (0.32-0.71 points).

Conclusions. Estimation of the coefficients of phenotypic consolidation among the sows, culled for various reasons, showed a different level of consolidation according to the researched features. Mostly, when calculating according to different algorithms, the most consolidated were the values of the total number of farrows, which is explained by the particularity of culling for each group. It should also be noted the differences in consolidated indicators for percent of weaned piglets and weights at weaning per litter between the sows culled for veterinary and breeding reasons. Non-consolidation, based on given indicators of the sows, culled for veterinary reasons, is explained by a number of specific reasons for culling within the group. Non-consolidation in the same indicators among the sows, culled for breeding reasons, is explained by a rather high consolidation level in the indicator of total number of piglets at birth, which has quite high influence share in the selection index.

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Authors:
Oleksandr Tsereniuk, Institute of Animal Science of UAAS, Laboratory of Small Husbandry and Horsbreeding, Ukraine, Kharkiv, 61026, Tvarinnikiv St. 1-A, e-mail: tserenyuk@gmail.com
Ruslan Susol, Odessa State Agrarian University, Department of Production and Processing Technology of Livestock Products, Ukraine, Odessa, 65012, Kanatna Str., No. 99, e-mail: r.susol@ukr.net
Oleksandr Bordun, North-Eastern UAAS Institute of Agriculture, Laboratory of Livestock and Feed Production, Ukraine, Sumy reg., Sumy distr., Sad, 42343, Zelena str., No. 1, e-mail: alexandrbordun777@gmail.com
Andriy Paliy, Kharkiv National Technical University of Agriculture named after Petro Vasylenko, Educational Scientific Institute of Technical Service, Ukraine, Kharkiv, 61050, Moskovsky Prospect, 45. of. 413, e-mail: paliy.andriy@ukr.net
Oksana Shkromada, Sumy National Agrarian University, Faculty of Veterinary Medicine, Ukraine, Sumy, 40021, H. Kondratiieva Str., No. 160, e-mail: oshkromada@gmail.net
Oleksandr Akimov, Institute of Animal Science of UAAS, Laboratory of Small Husbandry and Horsbreeding, Ukraine, Kharkiv, 61026, Tvarinnikiv St. 1-A, e-mail: akimov.kharkiv@gmail.com
Marina Tsereniuk, Institute of Animal Science of UAAS, Laboratory of Small Husbandry and Horsbreeding, Ukraine, Kharkiv, 61026, Tvarinnikiv St. 1-A, e-mail: tsemarina@ukr.net