SCIENTIFIC HORIZONS

Journal homepage: https://sciencehorizon.com.ua

Scientific Horizons, 24(1), 22-28

UDC 636.4.082
DOI: 10.48077/scihor.24(1).2021.22-28

ETHOLOGICAL METHODS FOR THE SELECTION OF YOUNG PIGS FOR HERD REPLACEMENT

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Article's History:
Received: 25.12.2020
Revised: 14.02.2021
Accepted: 16.03.2021

Suggested Citation:
Doylidov, V. (2021). Ethological methods for the selection of young pigs for herd replacement. *Scientific Horizons*, 24(1), 22-28.

Abstract. Ethologists have identified many aspects of animal behaviour, and their research experience can be used in agricultural production for the selection of animals with necessary behavioural qualities. The purpose of the study was to find labour saving and effective methods for the selection of young pigs for herd replacement, including identification of their behavioural characteristics in the context of industrial pork production. The method for the selection of young animals based on the viability index of newborn piglets was compared with other method, which takes into account the independent attachment of piglets to the front three pairs of sow teats. It was found that the probability of independent attachment of a piglet to anterior teats has a positive and high correlation with its viability index, with a correlation coefficient of 0.95. Piglets that occupied the front three pairs of teats during the suckling period significantly ($P \leq 0.001$) exceeded the rest in weight at the 21st and at the 60th days by 22.7% and 5.4%, respectively. When assessing the behavioural reactions of piglets weaned from sows in an artificially created stress conditions, groups of piglets resistant and not resistant to psychological (emotional) stress were selected for subsequent observation. Moreover, it was found that among the sows obtained from stress-resistant piglets, the superiority in fertility during the first insemination and the total proportion of farrowing was 11.1 p.p., in terms of multiple fertility – 2.6 piglets ($P \leq 0.05$) or 33.3%, and in terms of the share of those transferred to the main herd – 27.8 p.p. in comparison with the group of unstable ones. Based on the obtained results, the use of an ethological method for selecting piglets for herd replacement was substantiated, taking into account the independent attachment to anterior teats and an express method for selecting piglets based on their resistance to psychological stress

Keywords: ethology, selection, herd replacements, piglets, viability, stress resistance

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INTRODUCTION

Modern ethologists have identified many aspects of behaviour in animals of various species, from insects to predators [1]. Laboratory rats, pigeons, red junglefowls, horses, and close human relatives – primates – were used as the main model species in the study of animal behaviour. [2; 3]. The scientific advances allow for a better understanding of general cognitive processes. This leads to the creation of more effective strategies for both wildlife management and directional selection among domestic species. Such an approach allows selecting individuals that meet specific human requirements based on their behaviour [1].

The experience accumulated by ethologists can also be used in the conditions of agricultural production. An increase in the amount of livestock production can be achieved with the proper understanding of the behavioural activity of bred animals, which allows selecting animals that meet specific requirements [4].

In the pig breeding of the Republic of Belarus, despite the difficult current situation resulting from the epizootic of African swine fever, there are objective prerequisites for increasing the pork production based on the use of improved highly productive genotypes [5]. One of the criteria for increasing the pork production at industrial complexes is to increase the efficiency of the use of broodstock. This will allow, by increasing the multiplicity and safety of young animals, to increase the level of production without exceedance of the number of sows in farms [6].

At a number of pig breeding complexes in the Republic of Belarus, as a result of the recent slippage due to the threat of ASF, a specific self-replacement system is used. When organising the broodstock reproduction, the necessary piglets are not purchased from breeding plants, but are selected from the number of pigs born in own herds, with subsequent rearing and introduction into the main herd. In such a situation, breeders of industrial complexes need methods that allow them to forecast the future viability and productivity of piglets selected for the replenishment of a herd.

Earlier, to assess the strength and vitality of the offspring born in sows, Russian scientists proposed the use of the viability index of newborn piglets (VINP). It is determined by the ratio of the live weight of each scored piglet at birth in grammes to the time it adopts a standing posture in seconds immediately after birth. Determination of VINP allows assessing the viability of piglets already in the first minutes of life. Also it allows identifying, by subsequent ranking, physiologically immature individuals, i.e., unsuitable for the replenishment of a herd [7]. However, due to its increased labour intensity, this technique is of little use for widespread practice, especially in large farms with a significant number of daily farrowings. And in the Republic of Belarus, industrial production of pork is carried out mainly at such farms.

It is known that each piglet, in order to systematically obtain food, conquers one of the nipples of the sow's teats in the struggle with its peers. The selected teat is constantly used by this piglet during the entire suckling period. As a rule, the largest and most viable piglets occupy the three front pairs of the milkiest teats, subsequently consuming more milk than their peers from the rear teats [8; 9]. Attempts to introduce weaker piglets to the anterior lobes of the mammary gland to prepare them for weaning in terms of live weight do not give the desired effect. The weak pigs are still pushed away from the teat by the strong ones [8]. Therefore, the fact that a piglet occupies a sow teat, which belongs to the three front pairs, can be used as a criterion for its selection for replenishment of a herd.

At the same time, a number of studies suggest that the viability and future productivity of young farm animals is influenced not only by the initial physical development and the rate of subsequent gain in live weight [10; 11]. After all, every animal has a certain type of higher nervous activity from birth, which determines the psychological (emotional) resistance of a given individual to the impact of stress factors, both technological and social, that arise throughout life [10; 12]. While mild stress is beneficial for survival, severe stress exposure dramatically increases the risk of physical and mental health problems [13]. The most important link in intraspecific communication is the mutual orientation of individuals to signals that are directly related to the main processes of life [14].

In the social life of pigs kept at pig breeding enterprises in groups, the rank position occupied by each specific individual in such a group, conditions for its further existence and, as a result, its productivity and longevity are a consequence of the manifestation of primary behavioural actions associated with life and manifested when interacting with a changing external environment. In turn, the direction and severity of such actions is based on the psychological (emotional) resistance of the individual to the effects of stress factors [12].

The activation of the stress response after exposure to psychological (emotional) stressors causes a whole cascade of physiological reactions in the animal, which may even be detrimental if repeated or chronic [15]. The increased fear experienced at the same time positively correlates with the depression of the general condition of the individual and a decrease in the manifestation of exploratory behaviour [2; 16].

A hypothesis was put forward linking the depletion of self-control resources and an increase in anxiety in stressed individuals with a decrease in blood glucose levels. However, it was not confirmed [17]. It has definitely been established that in anxious, emotionally stressed individuals, the exploratory reaction slows down in the presence of even a mild threat. Such a response is not observed in non-anxious individuals,

which can effectively act by disconnecting from the stress factor [18].

To reflect the natural connections between the identified elements of behaviour and the consequences of their manifestation, a classification of these elements must first be established [11]. In pigs, such significant and opposite behavioural elements are the passive defensive reaction. It is expressed in the individual's desire to run away and squeeze into the corner of the pen, turning back to the source of stress. The reaction might also include exploratory behaviour, expressed in the individual's desire to reduce the distance from the source of influence, to sniff it or touch it. Manifestation of one of the above behavioural reactions testifies to the strength or weakness of the nervous processes directly related to the communication of an individual in the group, resistance to the effects of technological stress factors, and hence to the health and productivity of the animal. This suggests the feasibility of the identification of psychological (emotional) resistance or non-resistance of piglets to stress, as a criterion for their subsequent selection for herd replacement.

The purpose of the study was to find labour saving and rather effective methods for the selection of young pigs for herd replacement, including identification of their behavioural characteristics in the context of industrial technology of pork production.

In accordance with the objective, the following tasks were set:

1. Scientifically substantiate the ethological method for the selection of piglets for herd replacement, taking into account their individual attachment to the three anterior pairs of sow's teats.

2. Scientifically substantiate the ethological method for the selection of piglets for herd replacement, taking into account their resistance to psychological (emotional) stress.

MATERIALS AND METHODS

The experimental part of the study was conducted in 2011-2013 before the onset of the African swine fever epizootic in the Republic of Belarus. The final processing with the analysis of the data obtained during the experiments was carried out in 2020. Three scientific and practical experiments were carried out in the following conditions: the pig farm in Sitze Communal Unitary Industrial Enterprise; the pig-breeding complex of JSC Dokshitskiy Rayagroservice of the Dokshitsy district of the Vitebsk region; the pig-breeding complex of JSC Agrokombinat Voskhod in the Mogilev district.

In the Sitze pig farm, the object of research were 163 prenursery pigs from 19 sows. The pigs were ranked based on the VINP index. When observing the process of their independent attachment to the teats, a relationship between the value of this indicator and the result of such attachment was revealed. The assessment of the viability of piglets was carried out according to the value of VINP, which is determined after the birth of each piglet. Taking into account the value of this indicator, the piglets were conditionally divided into three groups: piglets with increased viability, where the VINP was 4.0 and higher (n=14); piglets with an average viability with the VINP from 3.0 to 3.9 (n=74); piglets with low viability with a VINP of 2.9 and below (n=75). To analyse the productivity of piglets, the dynamics of their live weight during the suckling period was estimated.

In the second experiment in the pig-breeding complex of JSC Dokshitskiy Rayagroservice, the influence of both the live weight in piglets at birth and their psychological resistance to stress on the growth rate of animals during the suckling period was assessed. The results obtained were analysed in three groups, into which the piglets were conditionally divided in accordance with their live weight at birth: small – weighing up to 1 kg (n=42); medium – weighing over 1 kg and up to 1.3 kg (n=82); large – weighing over 1.3 kg (n=68). In piglets, the dynamics of live weight was taken into account during the suckling period, and then, immediately after its completion. Resistance to psychological (emotional) stress was assessed using the ethological methodology developed at the Department of specialised animal farming of the Vitebsk State Academy of Veterinary Medicine. The technique consisted in assessing the behavioural response of each pig in an artificially created stress situation, taking into account the manifestation of either a passive-defensive reaction or exploratory behaviour by the individual. The source of stress was a red-coloured stick, one end of which was placed in a pen with a piglet nest some time after weaning them from a sow.

The third experiment was conducted in the pig-breeding complex of JSC Agrokombinat Voskhod. The pigs that were attached to the three front pairs of teats during the suckling period were identified for the replacement of a herd. At the end of the suckling period, testing for psychological (emotional) stress resistance was also carried out, according to the method described above. As a result, among the gilts selected for replacement, two groups were identified: resistant (n=36) and not resistant (n=32) to psychological stress. The health and productivity of animals of both groups was monitored during the period from weaning to transfer to the main broodstock. The study investigated the reasons for the withdrawal of animals in each group during the rearing period, as well as for the period from insemination to transfer to the main herd. At the first farrowing, the number of piglets born to sows was also taken into account.

The data obtained during all three experiments were biometrically processed using the MS Excel software.

RESULTS AND DISCUSSION

The results of studying the dynamics of live weight during the suckling period in individuals with different levels of viability are presented in the table 1.

***Table 1**. Growth dynamics of suckling piglets with different viability*

Piglet viability	n	VINP	Average live weight at birth, kg	Average live weight at the 21st day, kg	Average live weight at the 60th day, kg
Increased	14	4.4±0.10	1.14±0.02***	5.2±0.17*	15.7±0.36*
Average	74	3.3±0.03	1.03±0.01*	4.6±0.07*	15.3±0.10*
Low	75	2.7±0.02	0.99±0.01	4.0±0.05	14.6±0.09

***Note**: Significant difference between the average indicators of animals with increased and average viability in comparison with the indicators of individuals with a low viability index – *P≤0.05; *** P≤0.001*

When analysing the data in Table 1, it was found that piglets with an increased VINP value actually turned out to be physiologically more mature. Their average live weight at birth was 15.1% and 4.0% higher than those of their peers with average and low viability index. In the future, they were able to grow more intensively, which can also be seen in the table. The live weight of piglets with low viability and at the 21st day and at weaning was significantly (P≤0.05) lower than in individuals with a high and medium viability, respectively, by 28.8%-13.7% and 7.8%-4.6%.

In the course of observing the process of feeding piglets by sows, it was revealed that all individuals with increased viability were attached to the anterior teats of their mothers. Among piglets with medium and low levels of viability, 83.8% and 52.0%, respectively, were attached to the anterior teats. Analysis of the dynamics of the live weight of piglets during the suckling period also showed that the individuals that occupied the anterior teats had an average live weight of 4.7 kg at the 21st day, and 15.3 kg at the 60th day. They significantly (P≤0.001) outnumbered peers attached to the rear nipples in weight at the 21st day – by 0.9 kg or 22.7%, and at the 60th day – by 0.8 kg or 5.4%.

During the analysis of the correlation between the viability index of newborn piglets and their live weight at weaning at the 60th day, it was found that, in general, for all the studied pigs, the coefficient of such correlation was 0.60. At the same time, for piglets sucking only the front 3 pairs of teats it was already 0.95, and for the ones sucking rear teats – 0.98. Consequently, it was found that the ability of a piglet to occupy the front, milkier teats, and to lead in live weight by the end of the suckling period is in a high positive relationship with its VINP.

It is much less labour-intensive to identify the attachment of piglets to certain teats (with subsequent tagging and selection) than to estimate the VINP indicator for each piglet being born, especially during mass farrowing in pig farms.

The findings obtained in the second experiment, when studying the dynamics of live weight during the suckling period in individuals with different viability and different response to psychological stress are presented in the Table 2.

***Table 2**. Growth dynamics of suckling piglets depending on their live weight and psychological stress resistance*

Piglets by live weight at birth	Stress resistance	n	Average live weight of a piglet, kg			Absolute gain, kg	Average daily gain, g
			at birth	at the 21st day	at the 30th day		
Large	Resistant	32	1.46±0.01	5.7±0.05	7.5±0.07	6.1±0.07	202±1.6
	Not resistant	36	1.48±0.01	5.5±0.08	7.6±0.11	6.1±0.11	204±2.4
Average	Resistant	36	1.21±0.02	5.2±0.10	7.4±0.09	6.2±0.09	206±1.9
	Not resistant	46	1.20 ±0.02	4.9±0.08*	7.1±0.08*	5.9 ±0.09*	196±2.0*
Small	Resistant	18	1.00±0.01	5.2±0.25	7.1±0.26	6.1±0.26	204±5.7
	Not resistant	24	0.97±0.01	4.7±0.12*	6.7±0.08*	5.7±0.08*	190±1.7*

***Note**: Significant difference between the indicators of resistant and not resistant individuals within groups by weight at birth – *P ≤ 0.05*

When analysing the Table 2, it was found that during the suckling period, the growth rate of piglets with medium and low weight groups largely depends on their resistance to psychological stress. Thus, with practically the same live weight at birth in these groups, a significant (P≤0.05) decrease in the growth rate of not resistant piglets was established in comparison with individuals that are resistant to stress. The difference in absolute growth was 4.8%-6.6%, and according to the average daily gain – 4.9%-6.9%. The absence of a negative effect of stress instability on subsequent growth rate in initially large piglets can be explained by the following: they immediately occupied better teats, dominating over smaller peers due to their live weight and

size, which ensured an increase in growth in the future.

In the course of the third experiment, based on the subsequent culling of piglets in each of the groups, it was found that the culling of stress-resistant animals was 25% during the rearing period. Furthermore, no culls was noted among stress-resistant animals during this period. 12.5% of non-stress-resistant piglets and half as many of resistant piglets were discarded due to insemination failure and diseases during the gestation period. The reproductive qualities of the sows of first-litters with different resistance to psychological stress, which, over time, became the pigs selected for replacement, are presented in the Table 3.

***Table 3**. Reproductive qualities of the tested sows*

Stress resistance	Selected pigs, animals	Inseminated, animals	Impregnated by first insemination, %	Farrowed sows, %		Piglets per farrowing, animals		Transferred to the main herd, animals
				by first insemination	total	total	alive	
Not resistant	32	24	66.7	87.5	83.3	9.8±0.53	7.8±0.94	16
Resistant	36	36	77.8	100.0	94.4	11.2±0.32	10.4±0.29*	28
Total	68	60	73.3	95.5	90.0	10.5±0.42	9.1±0.62	44

***Note**: Significant difference in relation to the mean value – *P≤0.05*

When analysing Table 3, the superiority of animals resistant to psychological (emotional) stress was established over those not resistant: in terms of impregnation during the first insemination – by 11.1 p.p.; in the specific weight of animals farrowing from the first insemination – by 12.5 p.p.; and in terms of the total proportion of farrowed animals – by 11.1 p.p. When assessing the indicators of the prolificacy of first-litters, as the basis of their productivity (Table 3), it was found that this indicator in the group of stress-resistant sows was significantly higher by 2.6 piglets or 33.3% in comparison with the stress-resistant group. In terms of the number of stillborn piglets, stress-unstable sows exceeded stress-resistant ones by 2.5 times.

In general (Table 3), in the group of stress-resistant animals, compared to the group of non-resistant, the proportion of sows eventually transferred to the main herd was 27.8 p.p. higher.

In addition, a comparison of the average indicators of reproductive qualities for all stress-resistant sows indicated a pronounced tendency to their increase (Table 3). Thus, the first insemination rate and the proportion of farrowed sows among stress-resistant animals were 4.5 p.p. higher than the average values of the same indicators for all selected animals. Multiple pregnancies in stress-resistant sows were, respectively, higher by 1.3 piglets or by 14.3%; the number of weak piglets was lower by 16.7%; the yield of viable piglets was higher by 19%; the number of stillborn piglets was lower by 42.9%. The proportion of stress-resistant sows transferred to the main herd was higher than the total for all sows by 13.1 p.p.

Thus, attention to the resistance to psychological (emotional) stress when selecting young animals for herd replacement in the context of industrial pork production will reduce the cost of raising and maintaining broodstock. This is done by reducing the weight of animals leaving, both during the rearing period and during the examination based on the results of the first farrowing. The proposed method will facilitate the rearing of viable piglets for sow farrowing at enterprises.

CONCLUSIONS

Analysis of the research findings allows for the following conclusions:

1. It has been established that all piglets with an increased viability index of newborn piglets (VINP) during the suckling period were independently attached to the anterior teats of their mothers. In the animals with medium and low viability, only 83.8% and 52.0% of animals were attached to the three front teats, respectively.

2. The probability of a piglet to attach to the front teats and to lead in live weight by the end of the suckling period is in a positive and significant relationship with its VINP with a correlation coefficient of 0.95. Piglets from the front three pairs of teats significantly (P≤0.001) exceeded the rest in weight at the 21st day and at the 60th day by 22.7% and 5.4%, respectively. Based on the findings, the ethological method for the selection of the most viable piglets for herd replacement was scientifically substantiated, taking into account their attachment to the anterior teats during the sucking period.

3. The average live weight of piglets at birth in medium and low weight groups is practically the same. However, a significant decrease in the average daily gain in live weight in stress-unstable animals in comparison with stress resistant individuals by 4.9%-6.9% (P≤0.05) is noted.

4. It was found that among animals resistant to psychological (emotional) stress: the superiority in fertility during the first insemination and in the total weight of farrowing animals was 11.1 p.p. In terms of

multiple births – 2.6 piglets (P≤0.05) or 33.3%, in comparison with stress-resistant animals. Multiple pregnancies in the group of stress-resistant sows were significantly (P≤0.05) higher by 2.6 piglets or by 33.3%. In terms of the number of stillborn piglets, stress-unstable sows exceeded the stress-resistant ones by 2.5 times. The proportion of stress-resistant sows transferred to the main herd was 27.8 p.p. higher than in the stress-unstable group.

Based on the analysis of the obtained results, an ethological express method for selecting piglets for herd replacement was scientifically substantiated, taking into account their resistance to psychological (emotional) stress. The proposed method consists in assessing the behavioral reactions of animals in an artificially created stressful situation. The individuals manifesting exploratory behaviour are selected for herd replacement, and animals manifesting only a passive-defensive reaction are excluded from the selection process.

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ЕТОЛОГІЧНІ ПРИЙОМИ ВІДБОРУ МОЛОДНЯКУ СВИНЕЙ ДЛЯ РЕМОНТУ СТАДА

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Анотація. Етологами виявлено безліч аспектів поведінки тварин, і накопичений ними дослідний досвід може бути використаний у сільськогосподарському виробництві під час відбору особин з потрібними людині поведінковими якостями. Мета досліджень полягала в пошуку малотрудомістких та ефективних прийомів відбору молодняку свиней для ремонту стада з урахуванням виявлення їх поведінкових особливостей в умовах промислової технології виробництва свинини. Під час порівняння способу відбору молодняку за величиною індексу життєздатності новонароджених поросят з прийомом відбору, який враховує самозакріплення поросят

за трьома передніми парами сосків свиноматки, встановлено, що ймовірність самозакріплення поросяти за передніми трьома парами сосків свиноматки знаходиться в позитивній і високій кореляції з величиною його індексу життєздатності за коефіцієнта кореляції 0,95. Поросята, що займали передні три пари сосків протягом підсисного періоду достовірно (P≤0,001) перевершували інших по масі в 21 день і в 60 днів на 22,7 % і 5,4 % відповідно. За проведення оцінки поведінкових реакцій поросят, відібраних від свиноматок, у штучно створеній стресовій ситуації виділені для подальшого спостереження групи ремонтних свинок стійких і не стійких до психологічного (емоційного) стресу. Встановлено також, що серед свиноматок, отриманих із свинок стійких до стресу, перевага по заплідненості за першого запліднення і загальній питомій вазі опоросних становило 11,1 п.п., з багатоплідця – 2,6 гол. (P≤0,05) або 33,3 %, а за питомою вагою переведених в основне стадо – 27,8 п.п. у порівнянні з групою не стійкі. На підставі отриманих результатів обґрунтовано використання етологічного прийому відбору поросят для ремонту з урахуванням факту їх самозакріплення за передніми трьома парами сосків свиноматки й експрес-методу відбору поросят з урахуванням їх стійкості до психологічного стресу

Ключові слова: етологія, відбір, ремонтний молодняк, поросята, життєздатність, стійкість до стресів