STATE OF ONTOGENETIC ADAPTATION AND MAIN SELECTION-GENETIC INDICATORS OF THE SHEEP POPULATION

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The study was conducted in the conditions of a nucleus herd of sheep Kharkiv intrabreed type of the Prekos breed. By differentiating the population of ewes of two generations (n=126 mother-daughter pairs) taking into account the deviations of individual indicators from the average values production of wool and reproductive coefficients, 4 groups were distinguished, each of which is characterized by a different reaction in the organism-environment system: AA (increased in both signs), BB (decreased) and their corresponding combinations - AB and BA. In total, in the maternal and daughter generations of sheep, the proportion of animals in subgroups (AA + AB) was approximately the same, and was 46.8% and 45.3%, respectively, which is evidence of deviations close to the norm in the quality of genotypes, respectively - 3.5% and - 4.7%. According to the indicator of the sum of values in subgroups (AA + BA), the pressure of natural selection in the daughter generation is somewhat higher, compared to the maternal one. The deviation from the norm is -9.5% and -17.5%, respectively. Taking into account the peculiarities of the combination of the specified traits in animals of individual groups, in general, the ontogenetic adaptability of the compared generations to environmental conditions turned out to be the same, and was 1.032. This state of adaptation in the generation of daughters was observed against the background of their probable superiority at 12 months of age over mothers in production of wool by 9.4% (p<0.001) and live weight, by 3.9% (p<0.05).

An improbable decrease in reproductive ability was noted against the background of an increase in live weight and especially production of wool in the generation of daughters. At the same time, the values of phenotypic correlations between live weight and reproductive coefficients in the generation of mothers turned out to be significantly lower than in their daughters and amounted to +0.009 and +0.156 (for the first three years of breeding use) and +0.104 and +0.112 (for the entire life), respectively. Production of wool, on the other hand, had negative correlations, which in the compared generations decreased in the corresponding age periods from -0.163 and -0.149 (in mothers) to -0.063 and -0.007 (in daughters). The values of the reproductive coefficients in sheep of this population are characterized by a low level of heritability: 0.011 - for the first three lambings, and 0.003 - for the entire life period of reproductive use of ewes.

It has been proven that new lines are characterized by higher adaptive capacity, and their share in the genealogical structure of the herd is increasing.

Keywords: *adaptability, sheep, reproductive capacity, correlations, production of wool, combination of traits, heritability.*

СТАН ОНТОГЕНЕТИЧНОЇ АДАПТОВАНОСТІ ТА ОСНОВНІ СЕЛЕКЦІЙНО-ГЕНЕТИЧНІ ПОКАЗНИКИ ПОПУЛЯЦІЇ ОВЕЦЬ

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Дослідження проведено в умовах нуклеусного стада овець харківського внутрішньо породного типу породи прекос. Диференціацією поголів'я вівцематок двох поколінь (n=126 пар мати÷донька) з урахуванням відхилень індивідуальних показників від середніх значень настригів та коефіцієнтів репродуктивності, було виділено 4 групи, кожна з яких характеризується різною реакцією в системі організм – довкілля: АА (підвищений за обома ознаками), ББ (знижений) і відповідні їх комбінації - АБ та БА. Сумарно в материнському та дочірньому поколіннях овець частка тварин в підгрупах (АА + АБ) була приблизно однаковою, та складала відповідно 46,8% та 45,3%, що є свідченням близьких до норми відхилень в якості генотипів, відповідно - 3,5 % та - 4,7 %. За показником суми значень у підгрупах (АА+БА) тиск природнього добору в дочірньому поколінні є дещо вищим, порівняно з материнським. Відхилення від норми відповідно становить -9,5 % та -17,5 %. З урахуванням особливостей поєднання зазначених ознак у тварин окремих груп, в цілому онтогенетична адаптованість порівнюваних поколінь до умов довкілля виявилася однаковою, та склала 1,032. Такий стан адаптованості у поколінні доньок спостерігався на тлі вірогідної їх переваги у 12-місячному віці над матерями за настригом вовни, на 9,4 % (p<0,001) та живою масою, на 3,9 % (p<0,05).

Відзначено невірогідне зниження відтворної здатності на тлі збільшення живої маси та особливо настригу вовни в поколінні доньок. При цьому величини фенотипових кореляцій між живою масою та коефіцієнтами репродуктивності у поколінні матерів виявилися значно нижчими, ніж у їх доньок та склали відповідно +0,009 та +0,156 (за три перші роки племінного використання) та +0,104 і +0,112 (за усе життя). Настриги ж вовни, напроти мали від'ємні кореляції, які в порівнюваних поколіннях зменшувалися у відповідні вікові періоди від – 0,163 та – 0,149 (у матерів) до – 0,063 та – 0,007 (у доньок). Величини коефіцієнтів репродуктивності у овець цієї популяції характеризуються низьким рівнем успадковуваності: 0,011 - за перші три ягніння, та 0,003 - за по життєвий період репродуктивного використання вівцематок.

Доведено, що нові лінії відзначаються вищою адаптаційною здатністю, а їх частка в генеалогічній структурі стада зростає.

Ключові слова: адаптованість, вівці, відтворна здатність, кореляції, настриг вовни, поєднання ознак, успадковуваність.

Introduction. Changes in the breed composition of the modern sheep population in Ukraine indicate increased competition between imported and domestic breeds of specialized meat production over local breeds of combined meat-wool and wool-meat production. This is evidenced by the creation of a new Dnieper meat breed in Ukraine and the intensive spread of breeding sheep of imported breeds - Merinolandshaf, Texel,

Dorper, Charolais and others, which have a high conversion of feed into meat products and are characterized by high reproductive capacity. The indisputable advantage of domestic sheep breeds remains their high adaptability to various environmental conditions. The latter are experiencing significant deterioration due to increased temperature and decreased precipitation, and the associated deterioration of sheep feeding conditions during the grazing period. An example of this is the current 2024, an extremely dry year, with long periods of extreme temperature increases in the summer. In such conditions, domestic sheep breeds are able to compete with imported ones by directing the breeding process to successfully combine their inherent adaptability with a higher level of productivity.

In this regard, Werf J., Graser H.-U., Frankham R. (2009) note that adaptability is a fundamental characteristic of plant and animal genetic resources, which allows them to survive in their usual environment and adapt to changing conditions. Numerous breeding programs for farm animals are aimed at increasing productivity, but this is often accompanied by a decrease in their adaptability. Therefore, the use of more productive genetic resources is opposed by the question of whether they are adapted to local production systems.

Therefore, animal adaptation requires reaching certain compromises when developing and implementing breeding programs and selecting breeds for breeding in certain environmental conditions (Gaughan, J. B., Sejian, V., Mader, T. L., Dunshea, F. R., 2019).

This is also emphasized by the results of the studies of Sila W., Gachuiri C.K. et al. (2021). Summarizing the experience of five years of breeding of Red Masai sheep in the arid region of Kenya after their introduction, they note that in order to ensure a stable long-term increase in their productivity, it is necessary to apply breeding programs that cover large arrays of animals and compare the results of their breeding with indicators of productivity and adaptability in reference herds.

The need to take into account in breeding work a complex of such traits as reproductive ability and productivity of sheep throughout their lives is also emphasized in their studies by Kizilaslan M., Arzik Y., Behrem S. (2024). They consider this to be the key factors for the formation of the stability and profitability of the sheep breeding industry.

So, in modern conditions, an important theoretical and applied task for breeders is to study the patterns of the breed formation process, analyze changes in adaptability and genetic structure of populations under the influence of various breeding methods, assess the combinatorial ability of breeds, types and lines. Artificial populations, which are sheep herds, are complex biological systems, the development of which is aimed primarily at ensuring the required level of production of products of a certain quality. In this regard, assessing the state of such populations and developing methods for managing them should take into account a set of indicators such as: productivity dynamics, magnitude and forms of variability and inheritance of quantitative traits, animal adaptability, as well as the level of financial and energy costs for product production, etc.

As one of the forms of controlling selection changes in the population Kovalenko V.P., Nezhlukchenko T.I., Nezhlukchenko N.V. (2012) use the establishment of an adaptive norm of quantitative traits of typological groups of animals with different parameters and ontogenetic variability in certain technological conditions of maintenance and at different levels of their feeding. In this case, the division of animals into classes (M- - minus, M_0 - modal, M+ - plus) is used according to the most important selection quantitatively measured traits, exterior or linear parameters. Depending on the conditions of the "environment", the adaptability indicators of the selected classes may correspond

to one of the following three levels: optimal, suboptimal, or superoptimal. Adaptability at the optimal level is noted if the viability and reproductive qualities of animals are manifested against the background of their highest productivity.

For dairy cattle herds Polkovnikova O.P. (1992) proposed and modified by Pidpala T.V. (2022) a method of monitoring the state of their adaptation, which consists in determining the group structure of animals in terms of the combination of their deviations from the optimum in terms of milk yield and reproductive ability in adjacent generations.

Such a methodological approach allows us to assess, on the one hand, the impact of selection for milk productivity, and on the other hand, the pressure of natural selection on controlled livestock populations. That is, for the assessment, signs that are negatively correlated with each other are used - the average lactation expectancy of cows and the coefficient of their reproductive ability. The presence of such a connection is emphasized in their studies by Fedorovych V. V., Fedorovych E. I., Mazur N. P., Dyachenko O. B. (2019). In addition, according to Gorelik O. V., Gorelik A.S., Galushina P.S. et al. (2021), the impact of increasing milk productivity by more than 10 thousand kg of milk per cow per year on reducing their reproductive ability increases.

Regarding the sheep breeding industry, especially for sheep of the combined direction of productivity, the leading breeding traits are the shearing of wool and the live weight of animals. The indicators of the reproductive ability of sheep, which ultimately determine the level of selection intensity in herds and affect the possible volumes of mutton production, are to some extent competitive in terms of directing the nutrients of feed to the formation of products, especially wool. This is convincingly traced from the fact that almost all breeds of sheep that produce a large amount of fine wool have a multiplicity of only from 110 to 130 lambs per 100 ewes. High multiplicity, from 180 to 220 or more lambs, is inherent in breeds of sheep mainly with a low level of wool productivity - fur, meat, dairy directions. This is more clearly seen in the example of meat merinos and multi-fetal merinos of the "burula" type, which are significantly inferior in shearing to Australian merinos of all wool types. Kennedy J.P. (1967), studying the genetic and phenotypic relationships between fertility and wool production in two-year-old ewes of the Australian Merino breed of the "peppin" type, emphasized that shearing of unwashed wool and the number of lambs born and weaned from ewes had highly probable in value and negative in direction phenotypic correlations. Genetic correlations also had significant negative indicators and were characterized by significant standard errors.

Therefore, for a long time, research and development of breeding methods have been carried out that would ensure an increase in wool productivity and at the same time improve the reproductive ability of sheep. Now classic studies by Young, S. S. Y. and Turner H. N. (1965) show that the coefficient of heritability of multiparity in ewes of the Australian Merino breed after the first lambing is low and is 0.03, and after the second lambing it increases to 0.35. Among the factors that influence the degree of intrabreed variability of this trait are the age of the ewes, the level and quality of feeding, the insemination season, and the combination of climatic conditions. Despite the low level of inheritance and the influence of phenotypic factors on the degree of variability of this trait, these researchers nevertheless proposed effective breeding techniques that ensured an increase not only in wool productivity, but also in sheep fertility.

Ramos Z., Blair H.T., Barbieri I. et al. (2021) also report on the possibilities of the above-mentioned transformation in nucleus herds of fine-wool sheep in Uruguay, provided that long-term breeding work is carried out. Over a period of more than 20 years, breeders have managed to increase the shearing of washed wool, live weight, and

maintain a high level of reproductive ability of sheep by working to reduce the thickness of the wool. This has become the basis for increasing the economic efficiency of sheep production in general.

Thus, indicators of the reproductive ability of farm animals are indicators not only of the adaptability of populations to environmental conditions, but can also affect the overall efficiency of production. Therefore, constant attention is required to determine the level of animal adaptability in connection with the intensification of selection for a number of other productivity traits that are significant for general production. Given the relevance of the problem under consideration for the livestock industry over a long period of time and the need for its further solution, the purpose of this work was determined by us - to study the correlations between the indicators of reproductive ability and productivity of sheep, indicators of their heritability and to establish the state of adaptability of the sheep population and its individual structural elements under the influence of selection measures.

Materials and methods of research. The study was conducted on ewes of the Kharkiv intrabreed type of the Prekos breed in the experimental base of the Institute - the breeding plant, the state enterprise experimental farm "Hontarivka". The analysis involved the results of the assessment of 126 pairs of ewes, which represent a related chain of "mother-daughter". Wool productivity was estimated according to generally accepted methodological techniques (Ibatullin I.I. et al., 2017). In this case, shearings, as well as wool coefficients, were determined. The indicators were taken into account in the year of age. The live weight of sheep at weaning and at 12 months and older was taken into account according to the results of weighing animals with an accuracy of 0.5 kg, and the average daily gains (g/day) of live weight in lambs were determined by the calculation method based on the data of live weight accounting and the growth period.

The signs characterizing the reproduction indicators of ewes were estimated by the reproductive coefficients, defined as the ratio of the number of live and stillborn lambs to the number of reproductive years of each ewe. The contribution of ewes belonging to each of the factory lines to the progress of the population was determined by the ratio of the number of daughters selected for breeding use to their total number obtained at birth.

Adaptation to environmental conditions of two adjacent generations was assessed according to the methods of Polkovnikova O. P. (1992), Pidpala T. V. (2022), modified by us to the conditions of sheep breeding. On generations of related ewes, which form a mother-daughter chain, the average production of wool and animal reproductive coefficients were taken into account. At the same time, two levels of their phenotypic manifestation were distinguished, namely: increased (A) and decreased (B) - deviations from the average values, as well as the corresponding combinations of values: (A-A) - increased, or (B-B) - decreased level for both signs and the corresponding combinations of (A-B) and (B-A) options.

For each generation, the group structure (%) was determined; indicators of ontogenetic adaptation (F) and the values and directions of its change.

The level of adaptation of the generation to the environment was estimated by the coefficient, which takes into account the ratio of the sums of group components (A-A) + (A-B) and (A-A) + (B-A). The relative advantage of animals of the first half-sum of components was considered as a deviation from the optimum in the quality of genotypes, and the second - as an increase in the pressure of natural selection on the herd.

To determine the level of adaptation of sheep of individual lines, the formula modified for the conditions of an artificial population, which is a flock with selection regulated by the breeder, was used:

$$F = B \times P \qquad (1)$$

where F is the level of adaptation;

B is the % of selected for further th reproduction of the herd of female livestock;

P – the reproductive coefficient of one sexually mature individual.

The average values of the studied traits, their errors and the values of the correlation and inheritance coefficients were determined by biometrics methods using the MS Exel lost environment (Baranovsky D. I. et al., 2017)

Results of the studies. Changes in productivity under the influence of environmental conditions and selection were determined on two generations of ewes of the Prekos breed, which represent a related chain mother ÷ daughter. The type of birth of animals (from singletons or as part of a multiple litter), live weight indicators, shearing at one year of age, wool coefficients and reproductive coefficients were taken into account.

The studies established that among ewes of the maternal generation, the proportion of animals that came from twins was 21%, while among their daughters the similar indicator was 25%. Despite the mentioned minor differences in the type of birth, qualitative changes occurred in the daughter generation regarding the increase in live weight and wool productivity against the background of a decrease in reproductive ability. Thus, the live weight in the daughter generation increased by 3.9% compared to the indicators of their mothers (p<0.05). Since wool shearing has a positive correlation with live weight, in this case, a significant increase in wool productivity in the daughter generation can be considered as a consequence of selection for both of these characteristics (Table 1).

Table 1

Characteristics of two generations of ewes according to the main indicators of productivity and reproduction (n – 126 heads in each generation)

Gene ration	Live weight		Production of wool		Wool coefficient		Reproduction coefficient	
	M±m, kg	Cv, %	M±m, kg	Cv, %	M±m, g/kg	Cv,%	M±m	Cv, %
M	44,0 ±0,61	15,7	3,72 ±0,08	25,5	85,2 ±1,86	24,4	1,127 ±0,033	33,6
D	45,7 ±0,52	12,7	4,07 ±0,07	19,9	90,1 ±1,84	22,9	1,094 ±0,031	35,3
+/-,%	+3,9[3]	-	+9,4[1]		+5,8	-	-2,9	-

Note 1. M – mothers; D – daughters; +/- – ratio of D to M indicators.
Note 2. [1] - p<0,001; [3]- p<0,05.

The daughter generation significantly (p<0.001) exceeds their mothers in terms of wool shearing at one year of age, but is inferior to them in terms of the reproductive coefficient, which is calculated by the ratio of the number of lambs obtained from them on average for the entire period of breeding use. That is, an improbable decrease in reproductive ability is observed against the background of an increase in live weight and especially wool shearing in the daughter generation. At the same time, the correlation coefficients between live weight and reproductive coefficients in the mother generation turned out to be significantly lower than in their daughters and amounted to +0.009 and +0.156 (for the first three years of breeding use) and +0.104 and +0.112 (for the entire life), respectively. Production of wool, on the other hand, had negative correlations,

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which in the compared generations decreased in the corresponding age periods from - 0.163 and - 0.149 (in mothers) to - 0.063 and - 0.007 (in daughters).

Given the indicated correlations between the traits and the role of the reproductive ability of females in the formation of the population's adaptability to environmental conditions, in order to quantitatively assess the state of ontogenetic adaptation in generations of ewes and the magnitude and directions of its change, the animal population of both generations was differentiated, taking into account the deviations of individual indicators from the average values of shearing and reproductive coefficients (Table 2). In this case, 4 groups were distinguished, each of which is characterized by a different reaction of animals in the organism-environment system.

Table 2

Ratio of animals by combination of shearing and reproductive rate

Genera tion	all heads	AA		AB		BA		BB	
		n	%	n	%	n	%	n	%
M	126	27	21,4	32	25,4	24	19,1	43	34,1
D	126	13	10,3	44	35,0	28	22,2	41	32,5

It was found that in total in the maternal and daughter generations of sheep the proportion of animals in subgroups (AA + AB) was approximately the same, and was 46.8% and 45.3%, respectively, which is evidence of deviations close to the norm in the quality of genotypes, respectively - 3.5% and - 4.7% (Table 3).

Table 3

Characteristics of two generations of sheep by shearing wool and reproductive performance in the distribution groups

Performance indicators	Group	Subgroup by trait development	Maternal M±m	Daughter M±m
Production of wool, kg	I	A	4,56±0,13	4,77±0,16
Reproductive rate		A	1,493±0,04	1,469±0,07
Production of wool, kg	II	A	4,48±0,13	4,71±0,10
Reproductive rate		B	0,895±0,04	0,880±0,03
Production of wool, kg	III	B	3,05±0,10	3,48±0,09[2]
Reproductive rate		A	1,513±0,05	1,463±0,04
Production of wool, kg	IV	B	3,00±0,07	3,55±0,07[1]
Reproductive rate		B	0,862±0,03	0,805±0,04

Note [1] *- p<0,001;* [2] *- p<0,01.*

The increase in production of wool in sheep of the daughter generation occurred mainly due to the increase in the proportion of animals that combined high shearing with a non-significant decrease in reproductive ability. This is especially noticeable in ewes of groups III and IV. Judging by the sum of the values in the subgroups (AA + BA), the pressure of natural selection in the daughter generation is somewhat higher compared to the maternal one. The deviation from the norm is -9.5% and -17.5%, respectively.

At the same time, the level of productivity and reproduction of animals in individual groups determined a different indicator of their adaptability (Table 4).

Table 4

**Characteristics of two generations of sheep by state of relation (%) to
the optimum of wool shearing and reproduction indicators and adaptability
in the distribution groups**

Performance indicators	Group	Subgroup by trait development	Generation maternal	Generation daughter
Wool sheared, kg	I	A	122,6	117,2
Reproductive coefficient	I	A	132,4	139,6
Group adaptability coefficient	I	-	1,08	1,19
Wool sheared, kg	II	A	120,4	115,8
Reproductive coefficient	II	B	78,6	84,2
Group adaptability coefficient	II	-	0,65	0,73
Wool sheared, kg	III	B	82,0	85,38
Reproductive coefficient	III	A	134,2	140,0
Group adaptability coefficient	III	-	1,63	1,64
Wool sheared, kg	IV	B	80,6	87,0
Reproductive coefficient	IV	B	76,5	77,0
Group adaptability coefficient	IV	-	0,95	0,89

In general, animals of both generations of group II were characterized by reduced adaptability, in which, against the background of higher by 16-20% against the average level of shearing, there was a decrease in reproductive coefficients by 15-20%. At the same time, the deviation from the norm was higher in the maternal generation.

The best adaptability was also noted for the generation of daughters in group AA and slightly worse only in group BB.

Taking into account the above differences between individual groups, in general, the degree of adaptation of the compared generations of sheep to environmental conditions turned out to be the same and amounted to 1.032 (Table 5).

Table 5

Assessment of the adaptability of sheep of the compared generations

Group (combination of traits)	maternal structure, %	maternal structure, % groups	maternal structure, % generation	daughter structure, %	daughter adaptation coefficient groups	daughter adaptation coefficient generation
AA(I)	21,4	1,08	0,231	10,3	1,19	0,123
AB(II)	25,4	0,65	0,166	35,0	0,73	0,256
III(BA)	19,1	1,63	0,311	22,2	1,64	0,364
IV(BB)	34,1	0,95	0,324	32,5	0,89	0,289
			1,032			1,032

That is, the increase in shearing did not cause a violation of the ontogenetic adaptability of the daughter generation sheep.

The studies also assessed the magnitude of the correlations between the main indicators of productivity and reproductive ability in ewes of the compared generations (Table 6)

Table 6

The magnitude of the correlations between the signs of productivity and reproductive ability in related ewes of two generations

Pairs of traits	Values of r±mr in ewes of two generations	
	mother	daughters
Average daily gain from birth to 90 days of age		
- Number of lambs per ewes for the entire breeding period	0,043±0,089	0,090±0,090
- Reproductive rate for the entire breeding period	-0,112±0,088	-0,061±0,090
Live weight at 12 months		
Number of lambs per ewes for the entire breeding period	-0,114±0,088	-0,132±0,088
- Reproductive rate for the entire breeding period	0,104±0,088	0,112±0,088
Shearing of wool		
- Number of lambs per ewes for the entire breeding period	-0,226±0,085[2]	0,410±0,074[3]
- Reproductive rate for the entire breeding period	-0,149±0,087	-0,070±0,089
Wool coefficient		
- Number of lambs per ewes for the entire breeding period	-0,148±0,087	0,432±0,073[3]
- - Reproductive rate for the entire breeding period	-0,242±0,085[2]	-0,068±0,090

Note: [1] - p<0,001; [2]- p<0,01.

It was found that in both generations, the growth rate of ewes from birth to 90 days of age (weaning), as well as live weight at the age of 12 months, do not have a reliable correlation with the number of lambs and their reproductive coefficients for the entire period of breeding use. At the same time, the shearing of wool and the wool coefficient associated with it and live weight in ewes of the maternal generation have a negative reliable (p<0.01) relationship with the number of lambs and fertility, respectively. In animals of the daughter generation, on the contrary, both indicators of wool productivity with the number of lambs had a highly reliable positive relationship. And with the reproductive coefficient, although the relationship remained negative, its value significantly decreased compared to mothers, and amounted to -0.070 and -0.068, respectively.

According to the results of the regression analysis we performed, it was found that the total number of lambs that can be obtained from ewes of the daughter generation depends on the value of this indicator in their mothers by 34.5% (p<0.001). The total number of reproductive years in mothers also affects the similar indicator in their daughters by 41.3% (p<0.001). At the same time, the dependences between the values of the reproductive coefficients in mothers and their daughters turned out to be low ($\eta 2$ x =0.011, for the first three lambings, and 0.003 - for the entire period of reproductive use). The relatively higher coefficient of inheritance of the indicator of the number of lambs

obtained from ewes for the first 3 years of their breeding use (0.016) indicates the priority of its use in breeding work with this population of sheep.

A feature of the breeding work in the breeding plant (nucleus) is the use of linear breeding. Therefore, the general picture of its adaptability is formed by animals of individual lines. The degree of adaptability of ewes belonging to the existing line 9e89/108 and the new lines 1579/1625 and 4464/4487 was determined based on the results of their lambing in 2021 and the indicators of further selection and natural loss of ewes obtained from them. It was established (Table 7) that 101 ewes were obtained from ewes belonging to the line 1579/1625, with intra-line selection to rams of the same line.

Table 7

Level of selection of ewes of different lines

Lineage of ewes received	Total lambs, heads	Including		From the total number of ewes left for reproduction	
		rams	ewes	heads	%
1579/1625	184	83	101	54	53,5
4464/4487	354	177	177	90	50,8
9e89/108	110	55	55	27	49,1
-	648	315	333	171	51,4

Of these, after sorting for sale at 90 days of age according to growth rate, type of birth, correspondence to the type of herd and line, as well as due to natural attrition from birth to one year of age, 53.5% of the total number of offspring remained for further reproduction. Similar indicators in line 4464/4487 were 177 and 50.8%, respectively. The share of the herd selected for further reproduction in both new lines was higher compared to animals of the line 9e89/108, which has existed for 25 years, by 4.4 and 1.7 absolute percent, respectively. The average fertility of ewes of the same lines was also taken into account (Table 8). The average yield of lambs per lambing of a sexually mature female (reproductive coefficient) was the highest in line 1579/1625. Their advantage over ewes of other lines was 5.8% and 9.4%, respectively.

Table 8

Fertility of ewes of different lines

Lineage	Total lambs produced, head.	Number of sexually mature ewes, head.	Offspring produced per 1 ewe, head.			
			on average	by lambs		
				1-3	4-6	7 and more
1579/1625	184	144	1,28	1,23	1,46	1,08
4464/4487	354	294	1,21	1,21	1,31	1,17
9e89/108	110	94	1,17	1,31	1,12	0,92

Taking into account that the potential for multiple births in sheep is revealed when they reach 4-6 years of age, the indicated advantage of animals of this age of a given line increases by 11.5% and 30.4%, respectively. For animals of the existing line, the peak of multiple births appears from the first to the third lambing, while in new lines it noticeably shifts to 4-6 years of age of animals. At the same time, relatively greater multiple births are maintained in them even at an older age. Taking into account the values of the percentage of herd repair and multiple births of ewes, the adaptability of animals of the

evaluated lines was calculated. Having the corresponding adaptability coefficient of 0.684, ewes of line 1579/1625 exceeded animals of line 4464/4487 by 11.6% (absolute indicator 0.613) and line 9e89/108 by 19.2% (versus 0.574). This indicates that new lines are more competitive and their share in the genealogical structure of the herd is growing.

Discussion. Most of the existing publications cited in the introductory part of this article indicate that the indicators of the reproductive ability of sheep directly, and taking into account their complex interaction with other breeding traits, affect the efficiency of sheep production.

Regarding the indicators of the live weight of sheep, most publications show a positive relationship with the signs of reproductive ability. At the same time, a number of researchers (Ferguson M. B., Thompson A. N., Gordon D. J. et al., 2011; Slavova P., Laleva S., Popova Y., 2015) emphasize that only the influence of live weight and their fatness before insemination and during the reproductive cycle is significant on the reproductive ability of ewes. At the same time, the optimal live weight of ewes is considered to be the one that corresponds to the average value of this trait for the breed, and fatness is at the level of 2.5 to 3.5 points.

Michels H., Decuypere E., Onagbesan O. (2000), also noting the positive relationship between live weight in sheep with such an indicator as ovulation frequency, once point out its absence with the level of animal fatness, due to the state of interaction of the genotype with the environment. They also did not find any connection between the live weight of ewes and prenatal mortality of lambs among the breeds and lines they compared.

The features of the interaction in the genotype-environment system regarding changes in live weight under the influence of acute feed stress were revealed by Amiri S., Puillet L., Huau C. et al. (2023). The results of their study indicate that the stress response they established can be used as a criterion for assessing the lifespan of goats, the nature of lactation and the combination of milk productivity and reproductive ability. According to their data, longer-lived dairy goats better maintain the stability of live weight under stress, have a more even lactation curve and better milk quality, while their stress-sensitive peers are better adapted to the redistribution of feed nutrients to ensure such physiological functions as pregnancy and rapid achievement of the peak of lactation against the background of a sharp decrease in live weight in the first half of it. As a result, the duration of use of such animals is significantly shorter.

Research Ramos Z., Garrick D. J., Blair H. T. et al. (2023) prove that the thickness of the wool has no definite connection, while the indicators of live weight and the area of the muscle "eye" in one-year-old sheep are positively moderately or strongly correlated with most indicators of reproductive ability in already adult animals.

One of the important indicators that determines the live weight of adult sheep is the average daily gain during the first 12 months of their life. Ben Salem M., Rekik M., Ben Hamouda N. et al. (2009) conducted an experiment to determine the effect of changes in the live weight of young sheep during 200 days after weaning from their mothers on their subsequent reproductive ability. They found that in young sheep of the Barbary breed with superfine merino wool in desert conditions, due to a decrease in live weight after weaning, there is a significant delay in the onset of sexual maturity at the age of 13 months. However, due to the high phenotypic plasticity of sheep of this breed, improving the level of animal feeding allowed at the age of 18 months to obtain a lamb yield of about 80% regardless of the degree of previous loss of live weight.

The studies of Duman M., Şekeroğlu A., Aksoy Y. (2024) on the contrary prove that the reduced growth intensity of sheep of the Akaraman breed under the influence of environmental factors is one of the reasons not only for the decrease in live weight and

survival of lambs, but also for some deterioration in the subsequent reproductive qualities of adult sheep.

Significant variability from -0.36 to +0.11. correlations between maternal additive effects on live weight of lambs and direct additive effects on reproductive traits of sheep are noted in their studies by Walkom S. F., Brien F. D., Hebart M. L. et al. (2015).

The results of our research indicate that the average daily growth rates of ewes during their growth period from birth to 90 days of age do not have significant phenotypic correlations with the number of future lambs, and with the reproductive coefficients of ewes for the entire period of their breeding use.

Judging by the presence of negative correlations, larger at the age of 12 months are subsequently characterized by a shorter period of reproductive use. However, at the same time, the average multiplicity tends to increase, especially in the generation of daughters. As evidenced by the corresponding correlation coefficient +0.112, versus +0.104 in mothers. So, in general, the correlation dependence we found between the live weight of sheep and their reproductive qualities is consistent with most of the above publications. However, in our studies, its level has the character of a trend that persists in the compared generations, which may be a feature of the Prekos sheep breed of combined meat-wool direction of productivity. With an increase in the average level of the trait in the generation of daughters, the level of correlation of this trait with the coefficient of reproduction of animals throughout life increases somewhat.

Unlike live weight, the relationship between wool shearing and the associated wool coefficient was found to be closer in both generations of ewes. In ewes of the maternal generation, it had a negative probable (p<0.01) character with both the number of lambs and the reproductive coefficient. In animals of the daughter generation, on the contrary, a highly probable positive relationship was established between both pairs of traits, which is a consequence of directional selection. At the same time, a significant increase in wool shearing with a moderate increase in live weight in the daughter generation did not significantly affect the wool coefficient indicator. This is evidence of the preservation in the compared generations of the type characteristic of sheep of the combined meat-wool direction.

The presence of an average level of negative correlation between wool shearing and the number of lambs born is indicated in their work by Ramos Z., Garrick D. J., Blair H. T. et al. (2023). However, the researchers note that despite this complexity, it is still possible to simultaneously carry out selection to improve wool shearing and the reproductive ability of sheep. They consider the use of appropriately developed indices for the assessment and selection of animals that successfully combine these traits as a means of implementation. The complexity of selection even for the main indicator, which is associated with the adaptive ability of animals - with fertility, is due to its low level of heritability. According to Mokhtari M.S., Rashidi A., Esmailizadeh A.K. (2010) the number of lambs at birth and at weaning in Kermani ewes has low heritability indices, respectively 0.01 and 0.03 and repeatability 0.08 and 0.10.

Also, the heritability coefficients of fertility of meat sheep of Texel, Shropshire, Oxford Down and Suffolk breeds varied only in the range from 0.04 to 0.06, the absolute indicators of which were from 1.36 to 1.58 lambs on average per lambing. (Maxa J., Norberg E., Berg P., Pedersen J., 2007).

According to Kalaydzhiev. G. I. (2022), sheep of the Stara Zagora breed, with average phenotypic fertility values for the first lambing of 1.13, the second - 1.25 and the third - 1.29, had the corresponding heritability indices of the trait 0.183; 0.149 and 0.137. Despite the low level of heritability of the indicators of the reproductive ability of sheep, Kizilaslan M., Arzik Y., Behrem S. (2024). note that further studies of their correlations

with other breeding traits can significantly improve the sheep breeding systems in the region of fine-wool sheep breeding. Therefore, they propose to identify and include the most important lifetime indicators of reproductive ability and productivity of sheep in breeding programs.

The heritability coefficients determined by us also indicate insignificant dependencies between the values of the reproductive coefficients in mothers and their daughters. They turned out to be low, $\eta^2 x = 0.011$ - for the first three lambings, and 0.003 - for the entire period of reproductive use of ewes. The coefficient of heritability in generations of the indicator of the number of lambs obtained for the first three reproductive years of ewes turned out to be somewhat higher - 0.016 (p<0.05). Despite this, the methodological approach applied by us in the conditions of the nucleus for breeding sheep of the Prekos breed proves that along with the increase in wool productivity in the daughter generation, the state of ontogenetic adaptability in it remains stable, since the correlations between shearing and the main signs of reproductive ability change significantly in it and are somewhat strengthened with the live weight of animals at 12 months of age. Differentiation of the population of two generations of ewes of the Prekos breed, taking into account the deviations of individual indicators from the average values of wool shearing and reproductive coefficients and the selection of animals with AA and AB combinations of traits is an effective breeding tool for improving both traits.

Conclusions.

1. Differentiation of the population of two generations of ewes of the Prekos breed, taking into account the deviations of individual indicators from the average values of wool shearing and reproductive coefficients, did not reveal a deterioration in the state of ontogenetic adaptability in the daughter generation against the background of a probable increase in wool productivity (p<0.001) and live weight (p<0.05) over animals maternal generation.

2. Ewes of the line 1579/1625 with an adaptation coefficient of 0.684 exceed animals of the line 4464/4487 by 11.6% (absolute indicator 0.613) and the line 9e89/108 by 19.2% (versus 0.574).

3. The values of the reproductive coefficients of this population of sheep are characterized by a low level of heritability, 0.011 - for the first three lambings, and 0.003 - for the entire period of reproductive use of ewes.

4. The indicators of live weight at the age of 12 months of animals are positively weakly correlated, while the shearing of wool and wool coefficients also have weak, but negative correlations with the main indicators of the reproductive ability of ewes. Against the background of a likely increase in wool productivity and, to a lesser extent, live weight, these connections are somewhat strengthened in the daughter generation.

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