SELECTED METHODS OF FORMATION DESIRABLE PHENOTYPE OF DIFFERENT SHEEP BREEDS

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Abstract

Modern trends in the development of sheep breeding suggest an increase in the importance of meat characteristics of animals with the fullest possible preservation of wool productivity indicators, which is particularly in demand when organizing lamb production, combined with the application of remote aerospace methods for assessing pasture fertility.

The study of the relationship between morpho-biochemical blood indices and resistance to the live weight of young animals obtained from intra- and inter-linear selection of parents and the correlation analysis of the economically useful signs of mothers with their daughters made it possible to establish the degree of the prepotent influence of one mothers' sign on the manifestation of a similar trait in offspring.

The Caucasian breed ewes of the desirable line have the greatest heritability of wool fineness (21.1-22.3 μm), so as the Jalghin merino ewes of the fine line - (18.1-20.5 μm). The shearing of the washed wool was better inherited by the Caucasian breed animals of the desired line and its interlinear selection with the thick-wool line, as well as the Jalghin merino ewes of the strong line. The latter were characterized by the greatest degree of heritability of the live mass, as well as interlinear ewes when combined with long-wool and thick-wool lines.

At the age of 4 months, young ewes had the highest repeatability rates and did not have significant differences between linear and interlinear variants of breeding. With increasing age, the level of repeatability factors in all groups was reduced to values of 0.41 to 0.61. At the same time, it should be noted that the young ewes of the Caucasian variety with interlinear breeding had the living mass feature characterized by greater stability than the linear one.

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Key words: sheep, animal line, correlation, heritability, repeatability.

Introduction

In breeding practice, evaluation of the prepotent abilities of animals is very important, especially for updating the methodological principles of selection and breeding work in industrial sheep breeding, where selection is based on the application of the results of a comprehensive assessment of animals for a significant number of phenotypic signs of productivity.

An important role in increasing the efficiency of animal selection is studying the nature and magnitude of the correlation relationships between the main breeding features. It is known that in fine-wooled sheep there is a positive correlation between length, density, live weight and wool cutting and a negative correlation between the density, length and fineness of the wool. However, with long-term directional selection, the breeders manage to change not only the magnitude of the correlation, but also its nature (Sushentsova M. A., 2007; Tulegenov S., 2009), which is a desirable feature for the formation a modern phenotype of sheep with improved meat qualities.

Each breed, line, herd, as well as a separate feature, is characterized by its inheritance value, which can be used to characterize only that feature and that population on which it was obtained (Erokhin A.I., 1981).

The quality of pasture plants plays a significant role in the feeding of sheep. The study of pasture ecosystems is now necessary to be carried out using a variety of space aerial photography and geoinformation technologies. They allow simultaneously improving accuracy and reducing the time required to obtain reliable information.

Materials and methods of research

Sheep of different linear affiliation, obtained from crossing these lines in breeds - Caucasian and Jalgin merinos belonging to the breeding farms of the North Caucasus region of the Russian Federation, were the materials of the studies. Studies have been carried out to identify the phenotypic correlation between economic traits in ewes of different genotypes. Correlation coefficients in young sheep between morpho-biochemical indices, resistance to live weight, correlations between wool productivity and live weight were studied, the coefficient of heritability was determined from the doubled correlation coefficient between the "mother-daughter" pairs, the coefficient of repetitiveness was calculated by determining correlation in the same animals for live weight

in different age periods. Coefficients of correlation between phenotypic traits, heritability of the progeny of basic economic-useful traits, and the repetitiveness of traits were determined according to generally accepted methods (Yakovenko A.M., Antonenko T.I., 2015).

In our studies, groups of sheep grazed on pastures, the botanical composition of which consisted of legume-cereals (25: 75%): onobrychis, medicago, festuca pratensis, lolium perenne. The study of pasture ecosystems was carried out using an AS-32-10 aircraft-type unmanned aerial vehicle and DJI 900 hexacopter, Canon M10 camera. Chemical analyzes of feeds were performed using standard methods.

Results and discussion

Breeding of sheep in the lines promotes the creation of several directions in the breed of productivity, which leads to a qualitative variety of the breed. The use of interline crosses, allows to obtain the most combining options for further work of breeding in the lines (Kim E.S., Elbeltagy A. R., Aboul-Naga A.M. et all, 2016).

The application of knowledge about the correlation dependence between individual characteristics allows predicting the change of some characteristics during selection of others, which is important for successful selection work to create the desired phenotypes. The study of the interrelation between morpho-biochemical indicators of blood and resistance with the live weight of young sheep of Caucasian breeds and Jalghin merino obtained from intra- and inter-linear selection of parents is of great practical interest, which necessitated the determination of correlation coefficients.

It was found that the inter-linear ewes had the correlation higher in comparison with linear herdmate, the indices of metabolites of non-specific blood resistance in the studied sheep were rather high, which is due, respectively, to the higher intensity of the passage of metabolic processes in the body, and this is expressed in the increase in body weight gain (Table 1). Analysis of the data presented shows that the relationship between biochemical parameters and resistance (blood serum) with the living mass in the ewes from intra- and interlinear selection was positive.

Table 1. Correlation of morpho-biochemical indices and resistance with the live weight of young animals of different genotypes (30 heads in each group)

Breed (line, cross)	Index		
	Total protein	Lysozyme activity of blood serum	Bactericidal activity of blood serum
КА* (1-3 desirable type)	+0.27	+0.33	+0.41
КА (№ 95474 thick-wool)	+0.23	+0.20	+0.32
КА (№ 91595 long-wool)	+0.35	+0.28	+0.38
КА (♀1-3 desirable type ×♂№ 95474 thick-wool)	+0.25	+0.37	+0.39
КА (♀№95474 г thick-wool ×♂ № 1-3 desirable type)	+0.31	+0.40	+0.43
КА (♀№95474 thick-wool ×♂ № 91595 long-wool)	+0.37	+0.45	+0.47
КА (♀№ 91595 long-wool ×♂№95474 thick-wool)	+0.33	+0.32	+0.40
ДМ (fine)	+0.28	+0.20	+0.28
ДМ (medium)	+0.34	+0.22	+0.26
ДМ (strong)	+0.39	+0.42	+0.29
ДМ (♀strong ×♂medium)	+0.38	+0.46	+0.31

* Note: КА – Caucasian breed of sheep; ДМ – Jalgin merino breed

The correlation between the amount of total protein and live weight in young Caucasian breed of different genotypes from intra- and interlinear selection was positive and amounted, respectively, from r = + 0.23 to +0.35 and r = + 0.25 to +0.37. It was also found that the animals of the Jalgin merino breed, on average, had the superiority in the amount of the total protein in the blood serum (r = + 0.34), over the herdmates of the Caucasian breed by 0.04. The highest correlation in this indicator was in animals of the Jalghin merino type, r = +0.39 with which purposeful breeding for increasing the live weight is conducted, and animals from the interline cross (♀strong × ♂medium) were slightly less than 0.01 (r = +0.38), which is associated with a large fluctuation of live weight in animals in this group (21-33 kg). Among the animals of the Caucasian breed, the best indicator was the animals obtained by crossing the lines (♀№95474 thick-wool × ♂ № 91595 long-wool) r = + 0.37, and among the intralinear animals, line № 91595 long-wool - r = + 0.35. The lowest correlation was observed in animals of the Caucasian breed line № 95474 thick-wool r = + 0.23.

The indices of nonspecific natural resistance have a greater effect on the viability of the young animals, and the correlation relationship of the resistance indicators was positive within the limits of the Caucasian breed - by the lysozyme activity of blood serum in the intralinear selection ewes, from r = + 0.20 to +0, 33 and interlinear - from r = + 0.32 to +0.45, according to bactericidal activity of blood serum, respectively - from r = + 0.32 to +0.41 and from r = + 0.39 to +0.47.

The correlation relation in Jalgin merino ewes from the interlinear selection (♀Strong × ♂Medium) for lysozyme and bactericidal activity of the blood was higher, compared with the herdmates from the intralinear selection, which is confirmed by the results of the animals preservation in this group (92.3%), which higher in comparison with groups I, II and III from homogeneous selection by 4.2; 0.6 and 0.4%. Among linear animals, it is possible to distinguish the ewes from the lines in the type of wool "strong", characterized by large size and larger living mass, in comparison with the herdmates of the lines "fine" and "medium" respectively - by 0.22 and 0.20; 0.01 and 0.03, as well as having similar indices on lysozyme activity (r = + 0.42) and bactericidal activity of blood (r = + 0.29).

Reducing the correlation of blood indices and resistance in ewes from linear selection at 13 months of age is associated with a one-sided selection of parental pairs during several generations, which affects low growth of live weight and morpho-biochemical indices and nonspecific protective functions of the body.

Thus, the best correlation of morpho-biochemical indices and resistance with the live weight of the young animals was marked in animals from inter-linear selection, which is reflected in higher animal survival rates and in the increase in their live weight.

Table 2. Correlation of the indexes of wool productivity and live weight in the varieties of different genotypes (30 heads per group)

Breed (line, cross)	Index				
	Live weight – shearing of washed wool	Shearing of washed wool – length of wool	Length of wool – fineness of wool	Live weight – length of wool	Live weight – fineness of wool
KA (№ 1-3 desirable type)	+0.34	+ 0.36	+0.54	+ 0.35	+0.22
KA (№ 95474 thick-wool)	+ 0.31	+ 0.30	+ 0.58	+ 0.28	+0.19
KA (№ 91595 long-wool)	+ 0.36	+ 0.37	+ 0.52	+ 0.33	+0.28
KA (♀ № 1-3 desirable type ×♂ № 95474 thick-wool)	+ 0.26	+ 0.31	+ 0.46	+ 0.29	+0.21
KA (♀ №95474 thick-wool ×♂ № 1-3 desirable type)	+ 0.36	+ 0.32	+ 0.48	+ 0.34	+0.23
KA (♀ №95474 thick-wool ×♂ № 91595 long-wool)	+0.35	+ 0.42	+0.41	+0.33	+0.27
KA (♀ № 91595 long-wool ×♂ № 95474 thick-wool)	+0.31	+0.35	+0.45	+0.27	+0.20
ДМ (fine)	+ 0.33	+ 0.35	+ 0.47	+ 0.18	+ 0.14
ДМ (medium)	+ 0.32	+ 0.36	+ 0.49	+ 0.21	+ 0.12
ДМ (strong)	+ 0.40	+ 0.48	+ 0.51	+ 0.30	+ 0.23
ДМ (♀strong ×♂medium)	+ 0.38	+ 0.35	+ 0.51	+ 0.24	+ 0.31

In our studies, in ewes of different breeds and linear affiliation at the age of 13 months, correlation relationships were established between the main economic-useful traits - live weight and shearing of shaved wool and length of wool, length and fineness of wool, live weight and length of wool, live weight and fineness of wool (Table 2).

The analysis of the obtained results confirmed the pattern established earlier in the studies of a number of scientists about the average positive relationship between the shearing of washed wool, its length and fineness in sheep of fine-wool breeds. Thus, the correlation coefficients between these characteristics in own studies in the linear and interlinear varieties of the Caucasian breed and the Jalgin merino line with different types of wool ranged from 0.31 to 0.58. In this case, significant differences in these indicators between animals of different linear affiliation are not established. Nevertheless, it should be noted that in the Caucasian breed the combination of a thick- wool and long-wool lines strengthened the connection between the length of the wool and its shearing, in the Jalghin merino breed cross-linking strong and medium increased the conjugation between the length and fineness of the wool.

Thus, the selection of animals in the length of the wool will help to increase the fineness and shearing of pure wool. This circumstance must be taken into account when forming breeding goals, both in the improvement of individual lines and in the herd as a whole. The length of the wool can act as one of the main features for the long-wool line in the Caucasian breed and strong in the Jalghin merino breed, whereas for other lines it is necessary to take into account the combination of this trait with others, based on the specified productivity parameters.

The study of the connection between the living mass and the signs of wool productivity made it possible to specify that, regardless of breed and linear affiliation, the correlation coefficients had a positive value and ranged from low values of 0.12 to 0.19 to medium values of 0.31 to 0.40, on the insignificant and average interdependence of these features. Thus, in the ewes of Caucasian and European long- wool lines and with their interlinear breeding, as well as in Jalghin merino ewes of different lines, the correlation coefficient between live weight and wool shearing was in the range 0.31 ... 0.38, between live weight and length wool – 0.21 ... 0.34, between live weight and wool fineness – 0.19 ... 0.28.

The obtained data allow us to conclude that for merino sheep selection by live weight is not a determining factor in the formation of signs of wool productivity. Considering the fact that at present the living weight is one of the most important features determining the profitability of fine-fleeced sheep breeding, special attention must

be given to it in breeding programs. The established positive relationship between live weight and signs of wool productivity indicates that selection by live weight, combined with selection according to fineness, length and shearing of pure wool, can be effective for obtaining animals of a promising genotype combining high live weight and meat productivity and wool with given characteristics

Analyzing the herd by quantitative characteristics, the share of genotypic variability in the total phenotypic variety is determined by calculating the heritability factor (h2) (Table 3).

According to T. M. Lupi, J. M. León, S. Nogales et all (2016), in Australian sheep, the heritability of live weight is in the range from 0.12 ± 0.08 to 0.46 ± 0.10. The indices of our experiment were higher, and we connect it with the direction of productivity of the experimental animals and purposeful selection for increasing the living weight.

Thus, in Caucasian breed ewes with linear breeding h^2 the shearing and fineness of wool was in the range 0.48 ... 0.64, live weight - 0.54 ... 0.66, with interlinear breeding, respectively, 0.44 ... 0.62 and 0.52 ... 0.70. An analogous regularity was observed in the linear and cross-line Jalghin merino breeds: the range of values h^2 was from 0.36 to 0.64.

Table 3. Heritability of economic-useful traits in ewes of different genotypes (30 heads in each group), h^2

Breed (line, cross)	Live weight	Shearing of washed wool	Fineness of wool
КА (№ 1-3 desirable type)	0.64	0.62	0.60
КА (№ 95474 thick-wool)	0.54	0.42	0.64
КА (№ 91595 long-wool)	0.66	0.54	0.48
КА (♀ № 1-3 desirable type ×♂№ 95474 thick-wool)	0.52	0.58	0.52
КА (♀ №95474 thick-wool ×♂ № 1-3 desirable type)	0.60	0.62	0.44
КА (♀ №95474 thick-wool ×♂ № 91595 long-wool)	0.70	0.60	0.40
КА (♀ № 91595 long-wool ×♂ № 95474 thick-wool)	0.56	0.44	0.46
ДМ (fine)	0.40	0.44	0.42
ДМ (medium)	0.48	0.48	0.38
ДМ (strong)	0.64	0.58	0.38
ДМ (♀strong ×♂medium)	0.56	0.48	0.36

Note: КА – Caucasian breed of sheep; ДМ – Jalgin merino breed

Nevertheless, it should be noted that the ewes of desirable line had the greatest heritability of fineness and the density of wool among the animals of the Caucasian breed, among the Jalghin merino - the ewes of the fine line. The shearing of the washed wool was better inherited in the Caucasian breed by the animals of the desired line and with its interlinear selection with the thick- wool line, as well as the ewes of the Jalgin merino strong line. The latter were characterized by the greatest degree of heritability of the live mass, as well as interlinear ewes when combined with thick-wool and long-wool lines.

In general, the obtained data indicate a high genetic conditionality of the studied features and a high degree of genotype influence on phenotype formation in Caucasian breed and Jalgin merino breed. Apparently, a long-term, from generation to generation, selection of these important for the selection of Merino sheep signs, led to a decrease in the proportion of paratypic variability in their manifestation.

The coefficient of repetitiveness can be used for early evaluation of animals, so the greater the frequency of repetitiveness the more stable the indicators of this characteristic. Therefore, based on the value of the sign obtained at an earlier age, it is possible to predict the future productivity of the animal, believing that, with a large constancy of the trait, it will be close in the next measurements to the first obtained measurement.

The coefficient of r repetitiveness (r_w) was calculated by determining the correlation in the same animals for live weight in different age periods (Table 4).

Table 4. Repeatability of live weight in flats from intra- and interlinear selection

Group	Coefficient of repetitiveness, r_w		
	At the birth and 4 months	At the birth and 6 months	at 4- and 14 months
КА (№ 1-3 desirable type)	0.65	0.55	0.51
КА (№ 95474 thick-wool)	0.57	0.49	0.44
КА (№ 91595 long-wool)	0.70	0.65	0.61
КА (♀ №1-3 desirable type ×♂№ 95474 thick-wool)	0.60	0.56	0.50
КА (♀ №95474 thick-wool ×♂ № 1-3 desirable type)	0.67	0.60	0.56
КА (♀ №95474 thick-wool ×♂ № 91595 long-wool)	0.69	0.60	0.58
КА (♀ №91595 long-wool ×♂№95474 thick-wool)	0.63	0.59	0.52
ДМ (fine)	0.58	0.47	0.41
ДМ (medium)	0.61	0.51	0.49
ДМ (strong)	0.66	0.60	0.58
ДМ (♀strong ×♂medium)	0.64	0.59	0.56

Note: КА – Caucasian breed of sheep; ДМ – Jalgin merino breed

The highest repeatability factors - 0.58 ... 0.79 were found when comparing the live weight at birth and at 4 months of age. In this case, the values of the coefficients did not have significant differences between linear and interlinear variants of the breeding.

With increasing age, the level of repeatability factors in all groups was reduced to values 0.41 to 0.61. At the same time, it should be noted that in the Caucasian breed ewes with inter-linear breeding, the living mass feature was characterized by greater stability than in the linear one. Likewise, for the interlinear ♀strong × ♂ medium, the combination of Jalghin merino ewes was characterized by a higher frequency of repeatability of live weight at 4 and 14 months of age. Thus, the obtained results allow us to conclude that selection for live weight of ewes at an early age (4 months) can be sufficiently effective to increase this feature and to consolidate at the genetic level in the Caucasian and Jalghin merino breeds.

The nutritional value of feeds can be characterized by such indicator as vegetative index NDVI. So, this index on pastures on which the experimental animals were grazing was not less than 0.55 ± 0.03. Chemical analysis of feed showed that the content of crude protein in air-dry matter was 10.7%, humidity 3.6%, crude fiber 31.4%, raw fat 2.59%, crude ash 7.5%, exchange energy 8.2 kcal/100 g. It was found that when growing fine-fleeced sheep it is advisable to use pastures with an average NDVI of not less than 0.55.

Conclusions

1. The revealed higher correlation in crossed animals between live weight with morpho-biochemical indices and nonspecific resistance is reflected by higher rates of their live weight and preservation in the Jalghin breed from 2.2% to 10.2% and 0.4 up to 4.2 abs. %, for the Caucasian breed - by 5.4% and 1.9 abs. percent. in comparison with intralinear herdmates.

2. When breeding for raising meat productivity in fine-fleeced sheep is conducted, attention should be paid to the correlation between the live mass and the shearing of the washed wool and the live weight and length of the wool. Knowledge of the degree of heritability of individual economically useful traits is important for determining the selection effect, since there is a positive correlation between the coefficient of heritability and the actual development of a given trait, which depends on the prepotent properties of the animal and determines the efficiency of selection.

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