

EFFECT OF DIFFERENT METHODS OF SELECTION ON THE VARIABILITY OF WOOL PRODUCTIVITY IN FINE-WOOLLED SHEEP

Effets des différentes méthodes de sélection sur la variabilité de la production lainière chez les ovins à laines fines

Efectos de los diferentes métodos de selección sobre la variabilidad de la producción lanera en las razas ovinas de lana fina

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Studies on the effects of different methods of selection on the variability and correlated responses of productive traits in sheep are necessary for the development of optimal selection schemes and the elucidation of the causes of increased variability of characters in the direction there were selected.

One of the approaches to this problem are models of the effect of directed selection based on data records on productivity traits accumulated in farms as a result of many years of selection.

Experimental animals in this analysis of the effects of different selection methods and selection intensity on variability estimates and correlations of wool yield in mothers and daughters were flocks sheep of the Stavropol breed. Data records on sheep of the farm «Sovetskoe runo» were used.

The data treated concerned the wool yield of 7400 «mother-daughter» pairs from 92 sires. The data were collected from 1944-1964. Wool yield in mothers and daughters was estimated at first shearing. Correction factors were used for adjusting variations in levels of nutritional management.

Selection was carried out during two successive periods. During the first period mothers born in 1954 and daughters born in 1957 were selected; in all, 2548 mother-daughter pairs were analysed; during the second period mothers born in 1960 and daughters born in 1964 were selected (in all 598 pairs). These sheep served as models for testing four methods of selection. Intensity of selection varied in different schemes of selection; selection coefficient in dams ranged from 5-90 % and in sires it was 98 %; the dams were selected with wool weight of 6.0, 6.5, 7.0, 7.5 and 8.0 Kg and more. Five periods of selection were analysed. The estimates taken into account were: wool productivity in mothers and daughters, varia-

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bility (mean standard deviation (σ) and variation coefficient cv) as well as correlation coefficient of wool yield between mother and daughter and heritability estimates.

The analysis of the results of 20 years of breeding applied to the best part of the flock at the farm «Sovetskoe runo» has shown that wool yield in mothers increased by 3.25 Kg and in daughters by 2.52 Kg. As compared with the mothers, the phenotypical improvement of the daughters varied between 0.15-0.83 Kg ($P \geq 0.99$) depending on selection intensity applied to each subsequent generation. Weaker selection effect on wool yield seems to be due to the decrease of additive genetic variance. Thus, during 20 years (1944-1964) the genetic variance of wool yield decreased from 0.292 — 0.061 i. e., by almost by 5 times.

Let us consider how different methods of selection influence the development

First selection method. Phenotypic selection of different intensity was applied and variability of wool productivity in sheep.

to mothers. It was found that selection coefficient of wool yield increases considerably in mothers and only slightly in daughters with increasing selection intensity. For example, in mothers born in 1954 mean wool yield was 7.28 Kg, after selection with coefficient of 70 % it reached 8.46 Kg, i. e., increased by 16.2 %, whereas wool yield in daughters increased by 0.18 Kg (2.4 %). In this case, the slight influence of selection intensity applied to mothers on wool productivity of daughters is presumably due to the small additive variability of this character in the population. The resulting heritability estimate was 15.3 %.

The decrease of the phenotypic variability of wool yield in mothers as a result of selection did not affect the variability of this character in daughters. Mean square deviation and variation coefficient in mothers before selection was 0.96 Kg (13.2 %) and after selection (with coefficient 70 %) these estimates were reduced to 0.59 Kg and 7 % i. e., by 72.7 % and 88 %, respectively. The variability of this character in daughters was quite stable and $\sigma = 1.11-1.18$ Kg, $cv = 15.3-15.7$ %. It may be concluded that wool yield is a complex polygenic character.

Second selection method. The selection of mothers for genotype, i. e., for wool yield of their daughters has shown that with increasing selection intensity wool yield increases in daughters much faster than in mothers. Thus, in daughters, wool productivity rose from 7.3-9.5 Kg, by 2.2 Kg, and in mothers from 7.28-7.52 Kg, by 0.24 Kg, when selection coefficient was 90 %. When maternal genotype was under selection, variability estimates hardly changed, while in daughters they changed sharply. The mean square deviations and variation coefficient varied depending on the intensity of selection to which the mother was subjected ($\sigma = 0.96-1.09$ and $cv = 13.2-14.5$) and in daughters σ varied from 1.11-0.50 and cv from 15.3-6.1 %.

Thus, the selection of mothers for genotype increases mean wool yield in subsequent generations of daughters to a greater extent than the selection of mothers for phenotype.

Third selection method. It is a combined method which consists in the selection of mothers with low wool productivity whose daughters have high wool productivity, so that in the flock remain only those dams which give the best daughters with respect to wool yield, and, on the other hand, in the selection of mothers with high wool yield irrespective of the wool yield in their daughters.

When this method of selection is used, wool productivity increases considerably both in mothers and in daughters. Thus, when selection coefficient was 84 %, wool productivity in mothers increased from 7.28-8.14 Kg, by 0.86 Kg, and in daughters from 7.30-8.73 Kg, by 1.42 Kg. Wool productivity in offsprings increases faster than in parents. The variability estimates in mothers as well as daughters increases considerably. In mothers σ increases from 0.96-1.25 Kg and in daughters from 1.11-1.26 Kg. It is suggested that the increase of variability estimates may be due to the increase of the additive component of variability, which results in the increase of the component of non-additive variance of this character within the same variation range in the population.

Fourth method. It is also a combined method; the mothers with low wool productivity selected for phenotype are discarded, while mothers with high wool productivity are selected for genotype. This selection method, as compared with the other methods, increases wool productivity in mothers and daughters under the effect of selection of different intensity.

Thus, with selection coefficient 89 %, wool yield in mothers increased from 7.28-8.73 Kg, by 1.43 Kg. This selection method decreases variability of wool yield both in mothers and daughters. σ for wool yield in mothers decreased from 0.96-0.71 Kg, by 0.25 Kg, while in daughters the respective decrease was 1.11-0.80 Kg by 0.31 Kg.

Therefore, this method helps to produce a more homogeneous and highly productive population.

The four methods analysed, which are based on a model of sheep population, are used to different extent in practical breeding.

The consideration of the effects of the four selection methods and of selection intensity on the correlation coefficients of mother-daughter wool yields has demonstrated that, when the first method is used, that the correlation coefficient varies between +0.115 and +0.138 under selection of various intensity, while when the second method is used, the respective variations are +0.115 and +0.116. These estimates show that the selection of mothers with different intensity for phenotype and genotype affects to the same degree the components of additive and non-additive variability. As to the third selection method, the correlation coefficient between wool yield in mothers and daughters was $r = +0.115$, when there was no selection, and when selection coefficient was 84 %, $r = -0.525$. These results are probably due to the increase of the component of non-additive variability of the character analysed and the considerable decrease of additive component.

The analysis of the fourth selection method gave other results. The correlation coefficients (mother-daughter) tended to rise under the increasing influence of selection intensity. The correlation coefficient was +0.115 before selection; when selection coefficient was 89 %, r attained +0.169. These data indicate that the additive component of variability of wool yield did not decrease, rather is increased slightly. This increase is presumably due to the fact that sheep subjected to non-additive gene effect were discarded. It may be concluded that this selection method is most promising in that it gives the largest increase of wool yield in mothers and daughters and does not change the component of additive variability in the population.

This consideration of the effects of four different methods of selection and selection intensity on variability and mother-daughter wool yield correlations suggests that the relative contributions of additive and non-additive components of variability to total phenotypic variability change depending on selection method and selection intensity and, as a result, variability increases in the direction of the selection applied.

SUMMARY

The work shows the influence of different methods and intensity of selection upon the variability and correlation wool yield between mothers and daughters. It is established that depending on the methods of selection, there may appear in the phenotypical variability some changes of the ratio of additively to non-additively acting variability.

The most promising selection method is recommended when low-productive mothers are discarded by their phenotype, while highly productive are selected by the quality of their progeny. A mechanism of appearance of variability of polygenic features in the direction of selection is suggested.

RESUME

Ce travail montre l'influence de différentes méthodes et l'intensité de sélection sur la variabilité et corrélation de la production de laine entre les mères et les filles. Il est établi que, dépendant des méthodes de sélection, il peut arriver dans la variabilité phénotypique quelques changements de la proportion de la variabilité agissant additivement ou non-additivement.

La méthode de sélection la plus promettante est recommandée lorsque des mères peu productives sont rejetées par leur phénotype, alors que celles qui sont très productives sont sélectionnées par la qualité de leur lignée. On suggère un mécanisme d'apparence de variabilité de traits polygéniques dans le sens de la sélection.

RESUMEN

Este trabajo muestra la influencia de diferentes métodos y la intensidad de la selección en la variabilidad y correlación de la producción de lana entre madres e hijas. Está establecido que dependiendo de los métodos de selección pueden aparecer en la variabilidad fenotípica algunos cambios en la proporción de la variabilidad actuando aditiva o no aditivamente.

El método de selección más prometedor se recomienda cuando se desechan por su fenotipo las madres de baja producción, mientras que las de gran producción son seleccionadas por la calidad de su descendencia. Se sugiere un mecanismo de apariencia de variabilidad de rasgos poligénicos en el sentido de la selección.