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Selection of Healthy and Highly Productive Dairy Cattle

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Abstract **- Dairy cow breeding has become highly complex as progress is made into the understanding of which genes are responsible for which traits and how well a particular trait is passed from one generation to the next. The impact of industrial use of cows on following genetic parameters: phenotypic variability, correlation, repeatability and heritability of economically useful traits in the high producing dairy cows herd of black-motley breed with the high level of Holsteins has been studied. After setting the breeding objectives it is important to decide which traits can be used to select individuals for breeding, and these traits being known as selection criteria. With the increasing the period of use cows up to 7 or more lactations, coefficients of variation of all monitored indicators declined in connection with the removal of cows with extreme indicators of productivity and longevity during first 3-4 lactations. The correlation coefficients of milk yields during the first, highest lactation and in lifetime, regardless of the period of use is closely related to the life-long milk yield, milk yield per day of productive life and milk yield per day of life. The heritability coefficients (h^2) of the indicators of longevity with increasing period of use cows up to 5 or more lactations has tended to increase: by the age of first calving from 0.01 to 0.16, by the number of highest lactation from 0.18 to 0.33, by milking days from 0.10 to 0.30, by lifetime milk yields from 0.18 to 0.32, and by days of life from 0.01 up to 0.21. The highest repeatability of indicators of milk yield, milk fat, body weight of cows regardless of the duration of their use was for the adjacent lactations (1 and 2, 2 and 3, 3 and 4, 4 and 5, 5 and 6). With increasing distance of lactations from each other the coefficient of repeatability of these traits is lowered.**

Keywords **- Cow; Productivity; Longevity; Variability; Correlation; Repeatability; Heritability.**

I. INTRODUCTION

Dairy cattle breeding programs have been based on the selection for traits related to milk production, composition and other traits such as conformation, udder health and longevity. Planning efficient breeding programs in animal husbandry requires knowledge of genetic and phenotypic parameters. Efficiency of selection work, the definition of the breeding value of the animals and the establishment of breeding programs depend on the population-genetic parameters. The pace of animal improvement increases if the genetic situation in the herd is regularly taken into account. For developing effective breeding program, the following parameters used: variability, heritability, repeatability and interdependence of indicators. Efficiency of selection determined by the value of variability. The variability of trait is determining the genetic shift of sampled trait in the herd. Small degree of variation and overly big in any herd is undesirable, since the first leads to the fact that cannot be found in a herd of cows for its further improvement on one or another trait, and the second degree can lead to the large value of the regression, that is, return to the average indicators of herd in the offspring of animals. Variability characterizes the possibility of selection, the parameters of livestock reproduction. Heritability coefficient reflects the share of variability, caused by the heredity of animals, in the

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total variability of trait. Reliability of assessment methods of animals' qualities characterized the coefficient of repeatability. The higher the coefficient of repeatability, the more effective selection on this trait [2, 4, 6, 7].

Individual traits of animals vary with age, this cause to make adjustments when selecting cows. Due to the fac that in available literature is not enough information regarding the data on breeding and genetic parameters of productive and other economically valuable traits of dairy cows in relation to the period of production use, the goal was, on the example of high-yielding herd, to determine the actual breeding and genetic parameters of the traits of the productive longevity of cows in connection with the different periods of their productive use [1, 3, 5].

II. Materials And Methods

The study was conducted at Tripoli- Libyan Dairy Farm. Tripoli city is located in the north-western part of Libya at 32° 54' North latitude and 20° 4' East longitude, Tripoli city has a hot subtropical semi-arid climate with long, hot and dry summers with relatively wet and mild winters with a Mediterranean (dry-summer) rainfall pattern. Its summers are hot with temperatures that often exceed 38 °C (100 °F); average July temperatures are between 22 and 33 °C (72 and 91 °F). In December, temperatures have reached as low as 0 °C (32 °F), but the average remains at between 9 and 18 °C (48 and 64 °F).

Over the past 10 years' milk productivity of mature cows was 7118 - 9016 kg with 4.34% fat, 3.12% protein. The database included 388 cows with the term of removal from 1 to 11 lactations. In overall analysis included the indicators of development, milk productivity, reproduction and working lifespan by 34562 primary accounting records 1420 lactations.

Research methods: comparative, statistical and zootechnical analyzes. Biometric data processing and calculation of the criterion of difference validity between the average indicators of the different groups of animals were carried out using the software package MS Excel 2003.

III. Results Of Research

In the study of the variability of productive longevity and economically valuable traits of cows with different useful lives the highest values of the coefficient of variation of cows who completed only 1 lactation on the following parameters: the number of calving, the number of calves, dairy days, lifetime milk yield, milk yield and milk fat on 1 day (from 27.4% to 35.5%) are set (Table 1).

Depending on the term of using animals, period of service was characterized by greatest variability both on 1 lactation, and the average for all lactations (from 49.6% to 63.3% and from 25.9% to 59.3%, respectively).

Milk yield in the first, the highest lactation, milk yield of a lifetime, the number of milking days, days of life changed as well, depending on the age of the animals. Cows that have lived 1-3 lactation have higher indicators than those used for more than 4 lactations. In the first three lactation cows with extreme variants of indicators are eliminated from the herd: unproductive - by culling, highly productive - because of the lack of appropriate level of feeding. And so the animals who have lived 7 or more lactations have milk yield in the first lactation 5592 kg (Cv = 14,5%), and who have lived 2 lactations - 6295 kg at Cv = 19,4% ($P<0,001$).

On average, around all livestock, coefficients of the indicators variability of productive longevity and economically useful traits indicate their sufficient variability for effective selection in highly productive herd.

Economically useful traits of dairy cattle are linked and between them there is a complex relationship which is the result of the interaction of hereditary factors and the environment.

In the literature, information relating to the establishment of regular relations between milk yield and other economically valuable traits of cows due to the different periods of their use is not enough, and the knowledge of such regularities could significantly improve the efficiency of selection in the direction of increasing milk yields, the term of the productive use of animals and their lifetime productivity.

Attracting the attention of researchers to the problem of correlation is due, first of all, the necessity to improve animals not one by one trait, but on a range of key indicators without compromising their health. On the other hand, knowledge of the nature and extent of the correlation between desired traits affect the specific methods of selection breeding pairs in order to generate offspring with the best combination of these traits.

Population genetics distinguishes two interrelated forms of correlations: phenotypic, which characterizes the relationship between economic-useful traits of animals that is generated during ontogenesis and genetic, which means the degree of connection between the traits in close relatives (parents - descendants and others).

Table 1 – The variability of the indicators of productive longevity and economically useful traits of cows with the different periods of production use

Indicators	-	Term of use (number of lactations)							
		1 (n=21)	2 (n=93)	3 (n=104)	4 (n=68)	5 (n=38)	6 (n=31)	7 or more (n=33)	Average (n=388)
Age of first calving, days	M	881,6	837	862	875	875	845	880	861
	Cv, %	15,1	12,8	13,8	14,8	13,5	12,1	13,0	13,7
Milk yield (1 lactation), kg	M	4606	6295	6160	5837	5360	5190	5592	5848
	Cv, %	21,5	19,4	15,9	17,1	18,6	18,7	14,5	19,3
Average service-period, days	M	125	161	168	160	146	138	135	156
	Cv, %	49,3	59,3	46,8	36,1	25,9	29,1	26,6	45,9
Average period between calving, days	M	396	445	449	439	425	409	412	436
	Cv, %	14,1	21,5	17,9	13,0	16,1	10,8	10,5	16,8
Milk yield (highest lactation), kg	M	4606	7332	7689	7745	7719	7627	7416	7421
	Cv, %	21,5	18,8	18,3	15,8	26,2	19,8	13,9	20,9
Dairy days, all lactations	M	363	769	1157	1483	1845	2194	2745	1363
	Cv, %	33,8	24,0	18,8	17,5	12,5	14,1	18,7	49,8
Lifetime milk yield, kg	M	6023,4	16477	24704	31724	37667	44984	54807	28402
	Cv, %	34,7	28,1	23,4	23,8	23,0	23,9	21,7	50,9
Milk yield per 1 day of productive life, kg	M	16,8	21,5	21,5	21,4	20,4	20,5	20,1	20,9
	Cv, %	16,2	18,1	16,8	15,1	20,0	10,7	14,8	18,0
Days of life	M	1282	1743	2234	2642	3076	3448	4136	2477,5
	Cv, %	13,6	12,4	12,7	13,4	9,8	7,7	13,6	33,0
Milk yield per 1 day of life, kg	M	4,63	9,4	11,1	11,9	12,4	13,0	13,2	10,96
	Cv, %	27,4	23,7	19,7	19,9	23,1	21,8	14,6	27,6
Number of lactations	M	1	2	3	4	5	6	7,64	3,66
	Cv, %	-	-	-	-	-	-	14,5	49,2

Note: M – average value of trait; Cv - coefficient of trait variation

We determined the phenotypic correlation of the economically valuable traits of cows in relation to the timing of their use and showed it in Table 2, from which follows that the value of the correlation coefficient between the individual traits changedynamically.

So the correlation of milk yield per the first lactation with fat was insignificant and negative in cows lived 1-4 lactation (r = -0,09: -0,13); cows with the 5th and 6th finished lactation it was positive (r = 0,15 and r = 0,22), and with 7 - negative (r = -0,20). Correlation of milk yield per 1 lactation with the production of milk fat, with a service period, with term of use, with a yield for the highest lactation, life-long milk yield and complex indicators of longevity - milk yield on day of life and on the day of productive life - become less close with increasing the term of use animals.

A similar situation is observed with the correlation coefficients of milk yield for the highest lactation and lifetime milk yield with indicators of productive longevity and economically useful traits.

Thus, based on the results of the conducted correlation analysis found that the increase in the period of industrial use of cows from 1 to 7 lactations leads to weakening of the linkages between milk yield with indicators of longevity and other economic-usefulsigns (11,12).

The proportion of variability trait caused by the influence of genetic factors, that is, the heritability (h^2) is very important for breeding. It is known that at a high heritability trait (h^2> 0,6) selection by phenotype or mass selection are effective, and at a low (h^2 <0,2) breeding in herds should be carried out with the involvement of additional sources of information about the productive and breeding qualities of animals.

Heritability coefficients characterize the genotypic diversity of traits, depending on factors such as the degree of hereditary conditionality of trait, genetic heterogeneity of the study group and the influence of environmental factors operating in each population differently.

Therefore, the coefficients of heritability have not only a specific value for each herd but for each group of cows with different periods of use (see Table 3).

Highest h^2 by age of first calving in cows, that have completed 5 or more lactations is observed (h^2 = 0.16), for the other age groups, and the average for all animals - it is

small (0.01 to 0.06). By milk yield for 305 days of the first and highest lactations, milk yield per 1 day of productive life, heritability coefficients are significantly reduced in cows with 5 and more finished lactations compared to animals with two lactations.

Signs of longevity: dairy days, days of life, by contrast, has a higher heritability coefficient in connection with the term of use (5 or more lactations). Consequently, with the increase of the term of use cows up to 5 or more lactations, heritability coefficients of milk yield are reduced and signs of longevity, on the contrary, are increased. Therefore, the main factor affecting the longevity of cows this analysis did not reveal. For proper breeding use of cows, it is necessary to detect their potential capacity for high productivity as earliest as possible. Therefore, degree of traits repeatability by lactations in cows has great importance.

Investigated herd is characterized by repeatability coefficients between milk yield, fat content in milk, body weight, and service period that are given in Table 4. Analysis of the periodicity of milk traits for a number of lactations shows that by milk yield and milk fat for the adjacent lactations, regardless of the period of economic use, positive and statistically significant coefficients of repeatability are received. So repeatability of milk yield per 1-2 lactations ranged from 0.43 to 0.53, per 2 and 3; 3 and 4; 4 and 5; 5 and 6 lactations 0.52-0.66; 0.44-0.64; 0.36-0.52; 0.27 respectively.

The farther into the rank row are lactations, the lower the coefficient of repeatability of milk yield. For example, between the milk yield in the first and sixth lactations it was only 0.12, with the sixth and second - 0.22, for the third and sixth - 0.10(13).

Table 2 – Phenotypic correlations of (r) milk yields with indicators of productive longevity and economic-useful traits in cows with different periods of production use

Pairs of traits	Term of use (number of lactations)							
	1 (22 heads)	2 (92 heads)	3 (104 heads)	4 (68 heads)	5 (38 heads)	6 (31 heads)	7 and more (33 heads)	In average N=388 heads
Milk yield (1 lactation), kg:								
- fat, %	-0,013	-0,039	-0,01	-0,09	0.15	0,22	-0,20	0,05
- production of milk fat, kg	0,97 3)	0,94 3)	0,91 3)	0,92 3)	0,86 3)	0,97 3)	0,87 3)	0,98 3)
- service-period (1 lactation), days	0,31	0,29 2)	0,03	0,12	-0,27	0,37 1)	0,12	0,15 2)
- milk yield (highest lactation), kg	0,89 3)	0,71 3)	0,63 3)	0,64 3)	0,71 3)	0,68 3)	0,53 2)	0,62 3)
- lifetime milk yield, kg	0,85 3)	0,57 3)	0,53 3)	0,56 3)	0,49 2)	0,57 3)	0,48 2)	0,40 2)
- milk yield per 1 day of life, kg	0,83 3)	0,68 3)	0,64 3)	0,66 3)	0,64 3)	0,63 3)	0,41 1)	0,65 3)
- milk yield per 1 day of productive life, kg	0,50 1)	0,77 3)	0,65 3)	0,69 3)	0,49 2)	0,71 3)	0,66 3)	0,67 3)
- age of retirement, calvings	0,21	0,11	0,09	0,19	-0,12	0,28 2)	0,24	-0,09
- days of life	0,18	0,01	-0,02	0,04	-0,35 1)	0,36	0,14	-0,14 1)
Milk yield (highest lactation), kg:								
- service-period (average), days	0,35	0,18	0,21 1)	0,37 3)	0,09	0,23	-0,24	0,19 2)
- lifetime milk yield, kg	0,85 3)	0,71 3)	0,75 3)	0,74 3)	0,77 3)	0,62 3)	0,52 2)	0,49 3)
- milk yield per 1 day of productive life, kg	0,50 1)	0,84 3)	0,78 3)	0,83 3)	0,84 3)	0,85 3)	0,70 3)	0,80 3)
- milk yield per 1 day of life, kg	0,83 3)	0,81 3)	0,84 3)	0,86 3)	0,82 3)	0,93 3)	0,79 3)	0,81 3)
Lifetime milk yield, kg:								
- age of first calving, days	-0,01	-0,23 1)	-0,24 1)	-0,28	-0,36 1)	-0,29	-0,17	-0,06
- service-period (average), days	0,31	0,59 3)	0,56 3)	0,65 3)	0,38 1)	0,55 2)	0,05	0,13 1)
- days of life	0,65 1)	0,52 3)	0,46 3)	0,47 2)	0,73 3)	0,48 2)	0,43 3)	0,49 3)
- milk yield per 1 day of productive life	0,22	0,53 3)	0,57 3)	0,66 3)	0,81 3)	0,81 3)	0,45 2)	0,78 3)
- milk yield per 1 day of life	0,94 3)	0,88 3)	0,83 3)	0,80 3)	0,80 3)	0,93 3)	0,73 3)	0,80 3)

Note: 1) $P \leq 0,05$; 2) $P \leq 0,01$; 3) $P \leq 0,001$

Table 3 – The heritability of the indicators of productive longevity and economically valuable traits of cows with the different periods of production use ($h^2 = 2rM\text{-}D$)

Indicators	Term of use (number of lactations)				
	2 (n=80 pairs)	3 (n=74 pairs)	4 (n=36 pairs)	5 and more (n=36 pairs)	In average (N=226 pairs)
Age of first calving, days	0,14	0,01	0,06	0,16	0,06
Milk yield (1 lactation), kg	0,31	0,22	0,01	0,04	0,25
Service-period (1 lactation), days	0,21	0,07	0,10	0,28	0,19
Average service-period, days	0,24	0,25	0,01	0,20	0,27
Average period between calving, days	0,30	0,24	0,02	0,21	0,19
Number of highest lactation	0,18	0,26	0,32	0,33	0,21
Milk yield (highest lactation), kg	0,36	0,52	0,50	0,17	0,28
Dairy days	0,16	0,11	0,18	0,30	0,19
Lifetime milk yield, kg	0,18	0,18	0,01	0,32	0,18
Milk yield per 1 day of productive life	0,39	0,20	0,57	0,22	0,30
days of life	0,05	0,10	0,05	0,21	0,13
Milk yield per 1 day of life, kg	0,07	0,25	0,34	0,18	0,04

Table 4 – The repeatability of the economically valuable traits of cows

Compared lactations	The sample size (n)	Milk yield for 305 days, kg	Milk fat, %	Live weight, kg	Service-period, days
		Lim.	Lim.	Lim.	Lim.
First - second	546	$0,43^{3)}$–$0,53^{3)}$	$0,41^{3)}$–$0,67^{3)}$	$0,38^{3)}$–$0,82^{3)}$	$0,12 – 0,27^{2)}$
First - third	426	$0,30^{1)}$– $0,44^{3)}$	$0,33^{3)}$–$0,47^{3)}$	$0,25^{3)}$–$0,55^{3)}$	$0,01 – 0,22^{2)}$
First - fourth	276	$0,29^{2)}$–$0,40^{3)}$	$0,34^{3)}$–$0,48^{3)}$	$0,23^{2)}$–$0,56^{3)}$	0,07 – 0,07
First - fifth	150	0,11 – 0,11	$0,50^{3)}$–$0,53^{3)}$	$0,32^{2)}$–$0,49^{3)}$	0,02 – 0,04
First - sixth	68	0,12	$0,36^{2)}$	0,19	0,02
Second - third	426	$0,60^{3)}$–$0,66^{3)}$	$0,38^{3)}$–$0,52^{3)}$	$0,44^{3)}$–$0,70^{3)}$	$0,07$–$0,25^{2)}$
Second - fourth	276	$0,33^{2)}$–$0,40^{3)}$	$0,36^{3)}$–$0,60^{3)}$	$0,36^{3)}$–$0,73^{3)}$	0,05 – 0,14
Second - fifth	150	0,15 – 0,14	$0,14 – 0,51^{3)}$	$0,08 – 0,48^{3)}$	$0,06 – 039^{2)}$
Second - sixth	68	0,22	$0,24^{1)}$	0,26	0,16
Third - fourth	276	$0,44^{3)}$–$0,52^{3)}$	$0,21^{1)}$–$0,41^{3)}$	$0,45^{3)}$–$0,89^{3)}$	0,02 – 0,07
Third - fifth	150	$0,25^{1)}$–$0,36^{2)}$	$0,32^{2)}$–$0,52^{3)}$	$0,02 – 0,64^{3)}$	0,02 – 0,17
Third - sixth	68	$0,10^{1)}$	$0,40^{3)}$	$0,28^{1)}$	0,28
Fourth- fifth	150	$0,36^{2)}$–$0,52^{3)}$	$0,45^{3)}$–$0,49^{3)}$	$0,01 – 0,7^{3)}$	0,13 – 0,26
Fourth - sixth	68	0,18	$0,47^{3)}$	0,27	0,10
Fifth - sixth	68	$0,27^{1)}$	$0,43^{3)}$	$0,35^{2)}$	0,04

Note: Lim. – extreme variants; $^{1)}$ $P \leq 0,05$; $^{2)}$ $P \leq 0,01$; $^{3)}$ $P \leq 0,001$

Repeatability of fat content in the milk of cows with different terms of use proved to be more stable than milk yield; it may be due to the higher indicator of the heredity of butterfat compared with milk yield. Repeatability of live weight of cows with different term of use is similar to the repeatability of milk yield and the fat content of milk.

From the above it follows that the traits of milk production and live weight has in most cases very high and reliable coefficients of repeatability, allowing with a sufficient degree of reliability predict them by initial measurements.

IV. Conclusions

Heritability is one of the most important concepts in animal breeding. There are several working definitions, as heritability is used to help plan breeding programs, determine management strategies, estimate breeding values of individual animals, and predict response to selection. In general, traits related to fertility, fitness, health and survival have low heritability of less than 0.15. Production traits like milk or protein yield are moderately heritable, with h^2 from 0.15 to about 0.40. Product quality traits such as fat and protein percent tend to have the highest heritability's, above 0.40. The heritability of a trait is not the deciding factor in whether to include it in a genetic improvement program, as the economic value of even lowly heritable traits demands that they be changed by selection. Accuracy of selection for traits with low heritability can be improved with multiple measurements on an individual, use of pedigree information, and increased progeny group sizes. Estimations were made independently for each trait with a repeatability animal model, which included the direct additive genetic effect, as well as the permanent environmental effect of the cow. Genetic parameters were estimated with restricted maximum likelihood. In general, estimates of permanent environmental variance were greater than estimates of additive genetic variance, so that r was mainly determined by permanent environmental effects. Molecular genetic techniques such as genetic markers will become more important in helping producers change all economically important traits, though the opportunity to improve accuracy of selection will be greater for lowly heritable traits. Changes currently underway in the dairy cattle breeding industry will likely result in the use of more traits with low heritability's in selection decisions than have been used in the past. Selection of replacement cows and bulls was based on one of three following objectives: genetic merit for milk yield, milk and survival, and total genetic merit which included all five traits. Thus, the selection of cattle by economically valuable traits, evaluation of the results of breeding, forecast of its efficiency and definition of breeding value of animals should be carried out with the use of population genetic parameters, to predict the effect of selection on these traits. When selecting breeding animals, you need to be sure that these animals have a high genetic superiority, which will be inherited by the next generation.

References

[1] Basovskii, N.Z(1983). Population genetics in breeding dairy cattle / N.Z. Basovskii. - Moscow: Kolos,. - pp 6-44.

[2] Devyatkina, G.S. Characteristic of selection and genetic parameters of economically valuable traits of cows / G.S. Devyatkina, N.V. Molchanova, N.N. Sulima (2007). // PFUR Bulletin, - № 1 - 2. A series of agronomy and animal husbandry. - pp. 64 -68.

[3] Seltsov, V.I. (2006) The technique of creating high-dairy cattle herds (breeding aspects) / V.I. Seltsov, N.I. Strekozov, G.N. Krylova et al. / State Scientific Institution ARSRIF. - Dubrovitsy: ARSRIF, – 32 p.

[4] Ovchinnikova, L.Y. (2007) Genetic and population processes at Holstein breeding of black- motley cattle in Ural / L.Y. Ovchinnikova. - FSBEI HPE Ural SAVM: Troitsk,. - 210 p.

[5] Seltsov, V.I. (2014) Guidelines for selection and breeding work in dairy herds / V.I. Seltsov [et al.]. - 4th ed. - Dubrovitsy: All-Russia Research Institute for Animal Husbandry (VIZh),. – 96 p.

[6] Seltsov, V.I. (2006) The influence of the ancestors on the productive potential of the offspring /V.I. Seltsov // Materials of international scientific-practical conference: scientific works of VIZh. - Dubrovitsy: VIZh,. - issue 64. - pp. 129 - 133.

[7] Yakovleva, O.A. (2000) Repeatability of the traits of milk production / O.A. Yakovleva // Breeding, feeding, maintenance of livestock and livestock products (Issue 10). - FSBSE ARRIB. - Lesnye Polyany,. – pp. 14 - 17.

[8] Grachev V. S, Abdullaev A. O (2013). Age dynamics of indicators of dairy productivity of cows. Vestnik student's scientific society / scientific journal. - St. Petersburg, - P. 246 ... 249.

[9] Grachev V.S, Zhebrovsky L.S (2011) Genetic contribution of cows-recorders in improving the herd on dairy productivity of the agroindustrial complex: problems, condition, development prospects // Collection of articles of the First All-Russian Scientific and Practical Conference. - St. Petersburg, - P. 39 ... 42.

[10] Grachev V.S. Biometric (2012) processing of zootechnical data by means of EXCEL using the analysis package (methodical instructions) SPb,. - 48 p.

[11] Teimurian M., Aslmeninejad A.A. and Tahmuraspor M. (2011). Estimation of genetic parameters for production traits of Holstein cattle. Iranian J. Anim. Sci. 3, 179-184.

[12] Visscher P.M. and Thompson R. (1992). Univariate and multivariate parameter estimates for milk production traits using an animal model. I. Description and result of reml analyses. Genet. Select. Evol. 24, 415-430.

[13] Zishiri O.T., Cloete S.W.P., Olivier J.J. and dzama K. (2013). Genetic parameter for live weight traits in South Africa terminal sire sheep breeds. Small Rumin. Rese. 116, 118-125.