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Assessment of the genetic parameters and breeding value of bulls-producers of the Ukrainian black speckled milky breed by the main characteristics

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Abstract. Evaluation and selection of breeding bulls based on economically important characteristics is the main tool in modern systems of genetic improvement of dairy cattle. The purpose of the study was to analyse the influence of environmental and genetic factors on the traits of milk productivity, reproduction, productive longevity, and the difficulty of calving, to assess the genetic parameters and breeding value of breeding bulls based on these traits. The research material was data on the indicators of productivity, reproduction, and productive longevity of cows of the Ukrainian black speckled milky breed of the agricultural cooperative "Vostok" of the Kharkiv region. A multidimensional linear-threshold model was used to calculate genetic parameters (heritability coefficients and genetic correlations) and breeding values of breeding bulls. A probable phenotypic negative association was identified between calving difficulty and milk yield for 305 days (r= -0.2244±0.0266, P>0.999); an increase in calving difficulty by 1 point leads to a decrease in milk yield for 305 days of lactation by 1281.0 kg. Calculated estimates of genetic correlation indicate the presence of a fairly high relationship between milk yield for 305 days of lactation and the service period (over +0.5), a negative relationship between the service period and productive longevity (about -0.37), and a positive relationship between the service period and calving difficulty (about +0.26). This data indicates the presence of genetic antagonism between milk productivity and the level of reproduction of dairy cows, the negative impact of the extended service period on the length of stay of cows in the dairy herd, and the impact of calving difficulty on the deterioration of cow fertility. Estimates of the breeding value of breeding bulls by milk yield, service period, productive longevity, and calving difficulty were calculated. The results obtained indicate the expediency of including traits of reproduction, productive longevity, and difficulty of calving cows in the breeding index, which is used to evaluate and select bulls-producers of the Ukrainian black speckled milky breed

Keywords: dairy cattle, selection, threshold model, heritability, genetic correlation, calving difficulty

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Introduction

Evaluation and selection are powerful driving forces in modern animal husbandry, including dairy cattle breeding. For example, in the United States dairy cattle industry, milk production has increased by 80% since 1944, while the number of dairy cows has decreased by 65% (Mueller & Van Eenennaam, 2022). Selection breeding plays a substantial role in this. Unlike feeding and production technologies, which require constant costs, the genetic improvement achieved in one generation is passed on to subsequent generations of animals, that is, it has a cumulative effect. Therefore, improving methods for the genetic assessment of animals is of great practical importance in terms of accelerating genetic progress.

Modern breeding of dairy cattle is based on the genetic assessment of animals based on economically important traits. The range of breeding traits in dairy cattle breeding is constantly expanding and now includes, in addition to milk productivity, many other traits, such as reproduction rates, longevity, etc. (Cole *et al*., 2021).

An important breeding feature in dairy cattle breeding is the difficulty of calving (dystocia). The difficulty of calving is due to losses associated with increased mortality of calves and cows, reduced milk yields, poor reproductive capacity, and veterinary care costs. D. Malašauskien *et al.* (2022) identified that heavy calving leads to an increase in the incidence of lameness in dairy cows. A study by Morek-Kopec *et al.* (2021) showed that heavy calving increases the frequency of forced culling, especially in primiparous animals, which negatively affects the productive longevity of animals. Similar results were obtained by Fodor *et al*. (2020). The difficulty of calving is genetically related to another economically important trait – the birth of dead calves, which leads to a decrease in the number of valuable heifers (Sigdel *et al.*, 2022).

Mammi *et al*. (2021) identified that problematic calving is associated with reduced rumination and rest time for cows. The negative impact of heavy calving on the feed dry matter intake was also identified (Reshalaitihan & Hanada, 2019). A study by Antanaitis *et al.* (2021) showed that heavy calving causes a decrease in the concentration of lactose in milk and increases the risk of mastitis.

In the United States, estimates of breeding bulls on the difficulty of calving began to be officially published in 1978 (Miglior *et al.*, 2017). Today, in the United States, the difficulty of calving, along with the birth of dead calves, is included in the "calving ability" composite trait (Van Raden *et al.*, 2021). In the total merit index (TMI), which is used to evaluate and select the Norwegian Red breed, the ease of calving takes 2.9% (About Norwegian Red…, 2022).

Calving difficulty is expressed in points on 3-7-point scales (Tomka, 2018). In general, the difficulty of calving is characterised by low heritability – from 0.04 to 0.20 (Alam *et al.*, 2017; Silvestre *et al.*, 2019; Probo *et al.*, 2022). Genetic assessment of calving difficulty is performed using a linear or threshold model. The threshold model, which was first proposed by S. Wright, is theoretically more reasonable given the nature of this trait since it allows obtaining estimates of breed value in terms of a quantitative trait with a normal distribution (Ruban & Danshin, 2019), although its practical use is associated with certain technical problems, such as time spent on calculations, the convergence of estimates, etc. The optimal solution is to use a mixed linear-threshold multidimensional model to simultaneously estimate quantitative traits (e.g., milk productivity) and calving difficulty, considering genetic and environmental relationships between traits, which improves the accuracy of the estimate (Tomka, 2018).

The purpose of the study was to examine the influence of systematic environmental and genetic factors on the indicators of milk productivity (milk yield for 305 days of lactation), reproduction (service period), productive longevity, and difficulty of calving, an assessment of genetic parameters (heritability and genetic correlation coefficients) and breeding value of breeding bulls for these indicators.

Materials and Methods

The research material was the data of breeding accounting for indicators of productivity, reproduction, and productive longevity of cows of the Ukrainian black speckled milky breed of the agricultural cooperative "Vostok" of the Kharkiv region for the period from 2009 to 2021. The farm keeps 1,500 cows. They are kept in boxes with manure removal by mobile means and milking cows on two Parallel installations, 2×16. Cows are fed according to lactation phases (first phase – 1-120 days, second phase – 121-211 days, third phase – over 212 days) using total mixed ration (TMR). With an average milk yield of 28-34 litres per day, cows are fed 28-35 kg of silage, 12-15 kg of alfalfa haylage, 3-6 kg of hay, and 8-12 kg of grain mixture with minerals. One kilogram of dry matter of the total mixed ration contains 11.8-12.3 MJ of metabolic energy, 12-14% protein at the level of acid-detergent and neutral-detergent fibre of 19-20% and 35-38%, respectively.

All cows with completed lactation for 305 days (371 cows, 1346 lactations) were selected for the study. The assessment of breeding value was conducted for producers, daughters of which gave at least 10 lactations (a total of 30 breeding bulls were evaluated). Milk yield for 305 days of lactation was calculated using the interval method according to ICAR recommendations (Procedure 2 of Section 2…, 2020). The service period was calculated as the interval between the calving date and the date of fertilisation. Productive longevity was calculated as the interval between the date of first calving and the date of exclusion of the cow from the herd. The difficulty of calving was determined on a 3-point scale: 1 point – normal calving, 2 points – calving with minor complications, and 3 points – difficult calving.

Statistical data analysis (descriptive statistics, variance analysis, correlation, and regression analysis) was performed using the R version 3.6.0 environment (the R foundation of statistical computing).

The degree of influence of factors in the analysis of variance was determined by the formula:

$$\eta^2 = \frac{SS_{effect}}{SS_{total}} \quad (1)$$

where, SS_{effect} – sum of squared deviations for the effect under study; SS_{total} – total sum of squared deviations.

Calculations of genetic parameters (heritability coefficients and genetic correlations) and breeding values of breeding bulls were performed using the TM v.1.0 programme (Legarra & Varona, 2011). The following multidimensional linear threshold model was used:

$$y = Xb + Zs + e \quad (2)$$

where y – vector of observations (milk yield for 305 days of lactation, duration of the service period, productive longevity, and difficulty of calving of cows); b – fixed year-calving season effects vector and calving number; s – vector of additive genetic (breeding) values of breeding bulls; X and Z – plan matrices; e – balance vector.

Breed value estimates were calculated using the BLUP "breeder model" method (Schaeffer, 2019).

Reliability of breed value assessments (R) was calculated using the formula:

$$R = 1 - PEV/\sigma_a^2 \quad (3)$$

where PEV – prediction error variance; σ_a^2 – additive genetic trait variance.

These methods allow for assessing the probability and degree of influence of the main environmental and genetic factors on the characteristics under study, obtaining reliable values of genetic parameters, and calculating estimates of the breeding value of breeding bulls.

Results and Discussion

Tables 1 and 2 provide descriptive statistics on milk yield for 305 days of lactation, duration of the service period, productive longevity, and difficulty of calving of cows in SK "Vostok".

Table 1. *Descriptive statistics of productivity, reproduction, and productive longevity in SK "Vostok"*

Feature	n	M±m	σ	Cv, %
1 lactation				
Milk yield for 305 days of lactation, kg	371	7891.0±83.9	1615.5	20.5
Service period, days		133.1±2.2	42.0	31.6
2 lactation				
Milk yield for 305 days of lactation, kg	318	8512.6±104.6	1865.9	21.9
Service period, days		133.5±2.6	46.3	34.7
3 lactation				
Milk yield for 305 days of lactation, kg	274	8591.9±112.7	1866.0	21.7
Service period, days		136.0±2.8	46.1	33.9
4 lactation				
Milk yield for 305 days of lactation, kg	180	7974.3±139.3	1869.1	23.4
Service period, days		139.3±3.6	48.2	34.6
5 lactation				
Milk yield for 305 days of lactation, kg	95	8317.3±183.4	1787.6	21.5
Service period, days		135.2±4.7	45.5	33.7
6 lactation				
Milk yield for 305 days of lactation, kg	48	8283.2±265.4	1839.0	22.2
Service period, days		138.2±6.7	44.8	32.4
7 lactation				
Milk yield for 305 days of lactation, kg	28	6722.2±340.0	1798.9	26.8
Service period, days		139.8±8.8	46.6	33.4
8 lactation				
Milk yield for 305 days of lactation, kg	20	6585.0±370.3	1656.1	25.2
Service period, days		140.7±11.5	51.5	36.6
9 lactation				
Milk yield for 305 days of lactation, kg	7	7320.6±529.0	1399.6	19.1
Service period, days		121.7±11.8	31.3	25.7
10 lactation				
Milk yield for 305 days of lactation, kg	3	6543.7±983.3	1703.1	26.0
Service period, days		131.7±12.7	22.1	16.7

Table 1, Continued

Feature	n	M±m	σ	Cv, %
11 lactation				
Milk yield for 305 days of lactation, kg	2	7588.5±555.5	785.6	10.4
Service period, days		97.0±54.0	76.4	78.7
On average for all lactation periods				
Milk yield for 305 days of lactation, kg	1346	8185.6±49.9	1831.0	22.4
Service period, days	1346	135.1±1.2	45.2	33.5
Productive longevity, months	746	69.0±1.0	27.1	39.3

Notes: n – number of observations, M – arithmetic mean, m – standard error of the arithmetic mean, σ – mean square deviation, Cv, % – the coefficient of variation

Animals of the herd under study are generally characterised by a fairly high milk productivity. Milk yield increases in 305 days from the first to the third lactation, after which it decreases.

The duration of the service period gradually increases from the first to the fourth lactation, then decreases slightly, but then increases again and reaches its maximum value at the eighth lactation. In general, the value of the service period is too high, since it exceeds the duration of the service period in more productive cows of the Holstein breed in the United States, which is 114 days (Norman *et al.*, 2020).

The productive longevity of cows in this herd is about 5.8 years, which is a fairly high indicator for dairy cattle breeding. Thus, according to the data of de Vries & Marcondes (2020), the productive longevity of cows in countries with a high level of dairy productivity is from 3 to 4 years, and in a number of countries, such as France, Italy, Poland, and Canada, there is a downward trend in this indicator (Dallago *et al.*, 2021).

Table 2. *Descriptive statistics on the difficulty of calving in SK "Vostok"*

Calving difficulty, points	Number of calving sessions	Share, %
1	1224	91.3
2	105	7.8
3	11	0.9
Total	1340	100

The majority of calvings (91.3%) of primiparous animals and cows pass without complications, in 7.8% of cases they have minor complications, and only in 0.9% of cases difficult calving is observed (Table 2). For comparison, in Holstein cows in Italy, 79.5% of calvings are without any complications and 20.5% require the intervention of specialists (Probo *et al.*, 2022).

The correlation analysis identified a likely phenotypic negative relationship between calving difficulty and milk yield over 305 days (r = -0.2244±0.0266, P>0.999). Regression analysis showed that an increase in calving difficulty by 1 point leads to a decrease in milk yield for 305 days of lactation by 1281.0 kg. These results correspond well with the data of Atashi *et al.*, (2022), according to which heavy calving not only reduces milk yield in the early stages of lactation but also has a prolonged negative effect on milk productivity in general.

Table 3 shows the results of a variance analysis of the influence of factors "year – calving season", lactation number, father, and ease of calving on milk yield for 305 days of lactation, service period, and productive longevity.

Table 3. *Influence of environmental and genetic factors on milk during 305 days of lactation, service period, and productive longevity*

Factor	Milk yield of 305 days of lactation		Service period		Productive longevity	
	F	η^2	F	η^2	F	η^2
Year – calving season	23.177***	41.2	3.658***	11.8	8.379***	16.4
Lactation number	13.717***	4.7	0.993	-	-	-
Father	3.044***	8.3	0.979	-	24.332***	15.6
Ease of calving	4.208*	0.3	0.371	-	2.322	

Notes: F – Fischer criterion, η^2 – degree of influence, %, * – P>0.95, ** – P>0.99, *** – P>0.999

The "year – calving season" factor was highly likely to affect all the traits under study, while the lactation number had a likely effect only on milk yield for 305 days of lactation. The father of the cow substantially affected milk yield and productive longevity, but not the service period, which can be explained by the low heritability of this trait.

Similar results were obtained in other studies. For example, the likely effect of the season of the year and lactation number on milk productivity was established by Habibi *et al*. (2022). Ukita *et al*. (2022) identified a likely effect of the year and month of calving on the inflammation rate of Holstein cows in Japan. A study by Nejad *et al*. (2021) established the dependence of the risk of culling (and, accordingly, the duration of productive life) of cows on the season of the year.

Table 4 shows estimates of the genetic parameters (heritability coefficient and genetic correlations) of the traits under study.

Table 4. *Estimates of genetic parameters of milk yield for 305 days of lactation, service period, productive longevity, and difficulty of calving*

Feature	Heritability rate	Genetic correlation		
		service period	productive longevity	calving difficulty
Milk yield of 305 days	0.3341	+0.5229	+0.0943	+0.085
Service period	0.0830	-	-0.3688	+0.2571
Productive longevity	0.2045		-	
Calving difficulty	0.1787		+0.0410	-

The milk yield for 305 days of lactation had the highest value of the heritability coefficient. Productive longevity and calving difficulty were characterised by low heritability, while service period heritability was the lowest. The resulting assessment of the heritability of calving difficulty substantially exceeds the estimates obtained in the study by Sigdel *et al*. (2022), which were 0.06-0.07.

Regarding the genetic correlation coefficients, a fairly high relationship between milk yield for 305 days of lactation and the service period (over +0.5), a negative relationship between the service period and productive longevity (about -0.37), and a positive relationship between the service period and calving difficulty (about +0.26) are notable. These results indicate a known genetic antagonism between milk production and the reproduction rate of dairy cows (Canaza-Cayo *et al*., 2018; Yamazaki *et al*., 2020; Martinez-Castillero *et al*., 2020), the negative impact of the extended service period on the length of stay of cows in the dairy herd and the impact of the difficulty of calving on the deterioration of cow fertility (Probo *et al*., 2022).

Based on the use of a mixed multidimensional linear-threshold model, estimates of the breeding value of breeding bulls by milk yield, service period, productive longevity, and calving difficulty were calculated (Table 5). Breeding values of bulls by calving difficulty are expressed in terms of a quantitative trait with a normal distribution (average value is 0.00569, variance – 0.18166).

Table 5. *Estimates of the breeding value of breeding bulls by milk yield for 305 days of lactation, service period, productive longevity and difficulty of calving*

Breeding bull	Number of lactations	Milk yield for 305 days of lactation, kg		Service period, days		Productive longevity, months		Calving difficulty	
		BV	R	BV	R	BV	R	BV	R
FR3535222528	16	+722	0.62	+6.70	0.40	-1.40	0.09	-0.26	0.30
NL736463357	26	-290	0.71	-2.80	0.51	-0.90	0.48	-0.02	0.54
NL761829452	17	+385	0.62	+1.10	0.37	+0.30	0.13	-0.31	0.33
UA1800619813	14	+459	0.60	+2.30	0.42	-0.60	0.71	-0.24	0.30
UA3200801725	114	+4	0.88	+2.10	0.75	+0.10	0.93	+0.67	0.84
UA3200822444	50	-279	0.80	-0.10	0.66	+0.20	0.93	+0.28	0.77
UA3200822461	16	-130	0.64	-2.90	0.51	+2.80	0.88	+0.05	0.58
UA5600607819	13	-103	0.60	+0.60	0.44	-3.80	0.80	-0.37	0.14
UA5600607838	101	-104	0.85	-2.90	0.72	-3.20	0.87	-0.02	0.77
UA5900260662	124	-521	0.88	+0.90	0.75	-0.40	0.94	+0.27	0.83
UA6300108374	18	-364	0.62	-7.70	0.53	+4.70	0.87	-0.18	0.66
UA6300109103	19	-78	0.58	-1.40	0.51	+0.40	0.83	-0.12	0.61
UA6300109105	13	+135	0.53	+0.60	0.49	+6.20	0.81	+0.66	0.58
UA6300109106	37	-36	0.72	-1.50	0.61	+2.40	0.88	+0.37	0.80
UA6300109107	12	-92	0.55	-1.30	0.46	+0.40	0.83	+0.11	0.60

Table 5, Continued

Breeding bull	Number of lactations	Milk yield for 305 days of lactation, kg		Service period, days		Productive longevity, months		Calving difficulty	
		BV	R	BV	R	BV	R	BV	R
UA6300109108	11	+70	0.53	-5.60	0.46	+11.10	0.83	+0.58	0.64
UA6300309551	10	-93	0.48	-1.20	0.46	+1.60	0.81	+0.01	0.60
UA6300309555	32	+246	0.71	+0.50	0.57	+1.90	0.88	+0.32	0.77
UA6300376295	21	-158	0.69	-3.40	0.55	+2.10	0.88	-0.02	0.61
UA6300376594	40	-12	0.79	-1.20	0.65	+1.60	0.91	-0.08	0.72
UA6300446717	153	-1008	0.90	-6.40	0.76	-2.40	0.94	-0.19	0.77
UA6300447275	104	-146	0.88	+1.90	0.73	-2.00	0.92	+0.04	0.76
UA6300661596	21	-42	0.69	+1.20	0.53	+0.60	0.60	+1.03	0.66
UA6300755786	110	-240	0.87	-2.60	0.70	-4.00	0.90	-0.93	0.35
UA6300765661	32	+595	0.75	+3.70	0.53	-2.80	0.87	-0.64	0.26
UA6300777972	41	+280	0.79	+2.00	0.61	-2.30	0.75	-0.65	0.21
UA8000358181	12	+583	0.57	+4.40	0.30	+0.40	0.06	-0.09	0.14
UA8010591081	13	-183	0.60	+0.30	0.30	-1.80	0.02	-0.20	0.14
UA8010785745	22	-239	0.69	+0.20	0.44	-3.00	0.48	-0.37	0.30
UA8011167205	20	+493	0.69	+9.20	0.51	-2.20	0.69	+0.47	0.56

Notes: BV – assessment of breed value, R – reliability of assessment of breed value

The highest assessment of breeding value by milk yield for 305 days of lactation was given to FR3535222528 (+722 kg), UA6300765661 (+595 kg), and UA8000358181 (+583 kg) breeding bulls. According to the estimates of breeding value, the duration of the service period in bulls UA6300108374 (-7.7 days), UA6300446717 (-6.4 days), and UA6300109108 (-5.6 days) are notable. In terms of productive longevity, the best estimates of breeding value were given to bulls UA6300109108 (+11.1 months), UA6300109105 (+6.2 months), and UA6300108374 (+4.7 months). Regarding the difficulty of calving, bulls UA6300755786 (-0.93), UA6300777972 (-0.65), and UA6300765661 (-6.4) can be highlighted.

The obtained estimates of heritability coefficients are close to those obtained by other researchers, in particular, Stefani *et al*. (2021), although the heritability of milk yield at 305 days of lactation in this controlled study was higher (0.33 vs. 0.15). The use of a mixed linear threshold model allowed for a higher heritability coefficient for calving difficulty (0.1787) than when using linear models (Tomka, 2018; Silvestre et al., 2019), which allowed increasing the reliability of estimates of the breeding value of breeding bulls based on this feature. The decrease in milk yield for 305 days of lactation due to the difficult calving of cows is consistent with the data of other authors (Stefani *et al*., 2021).

The calculated values of genetic correlations confirm the well-known genetic antagonism between milk production and reproduction of dairy cows, which has recently been confirmed by genomic studies, the results of which showed that over 40 years (from 1964 to 2004), intensive breeding for milk productivity in the Holstein breed led to a deterioration in the reproduction rate of cows (Ma *et al*., 2019). 234 regions of the genome with selection signatures were identified, of which 125 regions either contained or were located near 198 genes affecting reproductive function.

Notably, the low level of heritability of reproduction indicators, including the service period, and the presence of an unfavourable genetic relationship between them and the milk productivity of cows does not mean that their genetic improvement by breeding methods is impossible. Weller *et al*. (2022) analysed phenotypic and genetic changes in milk productivity (milk yield, fat, and protein) and reproduction (fertilisation status, which is the inverse of the number of inseminations per fertilisation, expressed as a percentage) in the Holstein livestock population of Israel for the period from 1980 to 2018. The authors identified that in parallel with the increase in milk productivity, there was a decrease in the status of fertilisation from 55.6% in 1983 to 46.5% in 2018, but the average assessment of the breeding value of animals by fertilisation status increased from -1.9 to -0.1. These data indicate that the deterioration in reproduction rates was caused not by genetic, but by environmental factors. This is supported by the results of the study by Morton *et al*. (2018), according to which the proportion of non-genetic component covariance between reproduction traits and milk productivity is up to 67%.

According to Lucy (2019), breeding is a tool that allows for quickly improving the level of reproduction of dairy cows. In the Nordic countries (Denmark, Sweden, and Finland), reproduction rates began to be included in the breeding programmes of dairy breeds as early as the 1960s, which allowed for avoiding their deterioration with increased milk productivity (Muuttoranta *et al*., 2019). In the Holstein population of the United States, between 1960 and 2000, there was a steady decline in both the breeding value and the factual (phenotypic) values of the cow pregnancy level, then from 2000 there was a gradual increase in the factual values of the cow pregnancy level, and since 2010 (after the introduction of genomic assessment

of animals), there has been some genetic progress (Berry, 2018). Currently, two-thirds of Interbull member countries conduct a genetic assessment of dairy cattle based on reproductive traits (Interbull, 2022).

Thus, as a result of research, a substantial influence of environmental factors (especially the "year – calving season" factor) on the milk yield, service period, and productive longevity of cows of the herd under study was established. The presence of genetic antagonism between milk productivity and the level of reproduction of cows of the Ukrainian black speckled milky breed and the negative impact of heavy calving on the duration of the service period were confirmed.

Conclusions

The conducted studies indicate a substantial influence of the "year – calving season" factor on the indicators of milk productivity, reproduction, and productive longevity of cows, which makes it necessary to include this factor in the model for assessing the genetic parameters and breeding value of breeding bulls and cows based on the examined traits.

Heritability estimates (from 0.0830 to 0.3341) indicate the possibility of genetic improvement of all these traits through targeted breeding work.

The calculated values of genetic correlations confirm the existence of an unfavourable relationship between milk yield for 305 days of lactation and the service period (+0.5229), a negative relationship between the service period and productive longevity (-0.3688), and a positive relationship between the service period and calving difficulty (+0.2571). Such results indicate the negative consequences of breeding only for milk productivity for the level of reproduction of dairy cows of the Ukrainian black speckled milky breed and indicate the need to include traits of reproduction, productive longevity, and difficulty of calving of cows in the economic breeding index, based on which the assessment, selection, and breeding of animals will be conducted.

The use of a mixed multidimensional linear threshold model allows simultaneously assessing the breeding value of breeding bulls based on quantitative characteristics and those expressed in qualitative categories (calving difficulty). Using such a mixed multidimensional linear-threshold model, estimates of the breeding value of bulls-producers of the Ukrainian black speckled milky breed by milk yield, service period, productive longevity, and calving difficulty were calculated. The obtained estimates should be used in practice for the genetic improvement of this breed.

The obtained estimates of genetic parameters can be used in further studies when modelling possible genetic changes in the breeding traits under study (direct and correlated response to selection) under different selection scenarios and variants of breeding programmes in the Ukrainian black speckled milky breed.

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Оцінка генетичних параметрів і племінної цінності бугаїв-плідників української чорно-рябої молочної породи за основними ознаками

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Анотація. Оцінка та відбір бугаїв-плідників за економічно важливими ознаками є головним інструментом в сучасних системах генетичного покращення молочної худоби. Метою досліджень було проведення аналізу впливу середовищних і генетичних факторів на ознаки молочної продуктивності, відтворення, продуктивного довголіття і важкості отелень та здійснити оцінку генетичних параметрів і племінної цінності бугаїв-плідників за цими ознаками. Матеріалом досліджень були дані по показниках продуктивності, відтворення і продуктивного довголіття корів української чорно-рябої молочної породи сільськогосподарського кооперативу «Восток» Харківської області. Для розрахунку генетичних параметрів (коефіцієнти успадковуваності і генетичні кореляції) і племінних цінностей бугаїв-плідників використовувалась багатомірна лінійно-порогова модель. Виявлено вірогідний фенотипічний негативний зв'язок між важкістю отелення і надоєм за 305 днів (r= -0,2244±0,0266, P>0,999); збільшення важкості отелення на 1 бал призводить до зниження надою за 305 днів лактації на 1281,0 кг. Розраховані оцінки генетичної кореляції свідчать про наявність досить високого зв›язку між надоєм за 305 днів лактації і сервіс-періодом (більше +0,5), а також негативного зв'язку між сервіс-періодом і продуктивним довголіттям (біля -0,37) та позитивного зв'язку між сервіс-періодом і важкістю отелення (біля +0,26). Ці дані свідчать про наявність генетичного антагонізму між молочною продуктивністю і рівнем відтворення молочних корів, негативний вплив подовженого сервіс-періоду на термін перебування корів у молочному стаді і вплив важкості отелення на погіршення плодючості корів. Були розраховані оцінки племінної цінності бугаїв-плідників за надоєм, сервіс-періодом, продуктивним довголіттям і важкістю отелення. Отримані результати свідчать про доцільність включення ознак відтворення, продуктивного довголіття і важкості отелення корів в селекційний індекс, за яким здійснюється оцінка та відбір бугаїв-плідників української чорно-рябої молочної породи України

Ключові слова: молочна худоба, селекція, порогова модель, успадковуваність, генетична кореляція, важкість отелення