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EVALUATION OF BULL-BREEDERS ACCORDING TO THE LONGEVITY INDICATORS OF THEIR DAUGHTERS

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Abstract

Assessment studies of sires by indicators of lifelong performance of their daughters were performed in the herd of the raising Ukrainian Red-and-White dairy breed of the Mayak agricultural company, Zolotonosha district, Cherkasy region in Ukraine. The significant influence of bull-breeders on the lifespan, rates of productive use and lifelong performance of offspring, which was determined by personal inheritance of breeders, has been established. Changeability of daughters' lifespan of estimated breeders differed over a wide range – 3.005-3.462 days, terms of productive use – 2.188-2.626 days, and number of used lactations from 2.5 to 5.6. By the best rates of lifelong dairy productivity was differed the progeny of breeders with higher lifespan and productive use. The highest yield for one day of life and productive use was obtained by offspring of sires, which had higher rates of milk production during the first lactation and shorter longevity. The level of relationship between the yields for 305 days and lifespan indicators of sire's offspring differed by significant variability from moderate negative with longevity (r=-0.244) to positive with productive use (r=0.259). Obtained correlations between milk yield value for the first lactation and lifelong productivity of the offspring of evaluated breeders by the degree (r=0.055–0.659) and reliability (P<0.05–0.001) were characterized by positive and reliable values. This was certifying the possibility of milk yield during the first lactation to be a predictor of cows' lifelong production. The high productivity of daughters of the estimated breeders during the first lactation did not provide a similar growth in their economic use, but will guarantee lifelong milk productivity. The offspring of sires of domestic selection were not inferior by the productive longevity indicators to the offspring of purebred Holstein breeders.

Key words**:** *Holstein, Ukrainian Red-and-White dairy, sires, duration of use, lifelong productivity, milk yield, milk fat*

INTRODUCTION

The created Ukrainian specialized dairy breeds have been improved for a long time in the direction of increasing the traits of milk productivity. This did not take into account the functional state of the organism, especially indicators of longevity. High indicators of lifelong productivity are the result of good development and functioning of all organs and vital systems of the whole organism of cows [5]. Since lifetime productivity was not only a selection trait but also one of the main factors influencing the economic development of the dairy cattle industry. [6, 8], conducting research in this area was relevant and motivated. Therefore, studies on this issue have testified great interest by significant number of scientists, especially in countries with developed dairy farming [1, 14, 22].

The problem has long been covered in the domestic literature [10, 23, 25].

Lifetime productivity indicators were controlled by a large number of factors, both genotypic and paratypic.

Given the low indicators of the strength of impact on the duration use and cow's lifetime productivity and their low hereditability, [7, 8, 16, 27] affirmed that the effectiveness of breeding in mass selection to improve productive longevity traits won't be significant. Therefore, the most effective method in the breeding system was the selection of bull-sires, which are characterized by productive longevity of their daughters. For example, about it was reported [5]. [5]. [3] that the variability of lifetime indicators of sire's daughters was significantly reliable. By the life expectancy within 1,422–3,057 days and by lifetime milk yield 8,551–46,530 kg.

Given that the genetic improvement of breeds in dairy farming depending on the sires heredity by 90-95% [4], the aim of these studies was to examine their impact on the their daughter's longevity traits with definition of improvers.

MATERIALS AND METHODS

The experimental base was a farm for breeding Ukrainian Red-and-White dairy breed (URWD) in the agricultural enterprise "Mayak" of Zolotonosha district of Cherkasy region of Ukraine.

Assessment of duration and effectiveness indicators of lifetime use was performed by the method of [26], taking into account the date of birth (D_b), first calving (D_{fc}) and withdrawal (D_w). For each lactation $(i = n)$ its duration (D_{li}), milk yield (MY_i), content $(\% F_l)$ and milk fat yield (MF_i) for the whole lactation. Indicators of duration and selection efficiency of cows lifetime use were calculated by the following formulas: life expectancy (days) – $L_e = D_w - D_b$; duration of economic use (days) – $D_{eu} = D_w - D_{fc}$; lifetime milk yield (kg) – $MY_l = \sum MY_i$; lifetime milk fat yield (kg) – $MF_l = \sum MF_i$; average lifetime fat content in milk (%) – % $F_l = MF_l \times 100 / MY_l$; average milk yield per one day of life (kg) – $MY_{dl} = MY_l / L_e$; average yield per one day of economic use (kg) – $Y_{deu} = MY_l / D_{eu}$; number of used lactations (pcs.) – $N_{ul} = \sum N_{ul}$. Coefficient of economic use (C_{eu},%) was determined according to the formula given by [24] – $C_{eu} = (C_{le} - C_{afc})/C_{le} \times 100$, where: C_{le} – cow's life expectancy, days; C_{afc} – cow's age at the first calving, days.

Statistical processing of experimental data was carried out according to the formulas given by [21].

RESULTS AND DISCUSSIONS

The study of the traits characterizing the productivity, life expectancy and economic use of the daughter offspring of Holstein (Hol.) and Ukrainian Red-and-White dairy breeds testified a reliable variability of the estimated traits under the impact of their inheritance. (Table 1).

Table 1. Indicators of performance and length of use of offspring sires, x ± S.E.

Sire	Breed	n	Milk yield of the first lactation, kg	Duration:		C_{eu},%	Number lactations, pcs.
				life, days	economic use, days		
Inhibitor 402151	Hol.	115	7,956±128.2	2,247±57.9	1,417±59.0	63.2±1.13	3.1±0.13
Intul 401806	Hol.	62	7,844±229.4	2,299±97.3	1,465±99.3	62.3±2.04	3.0±0.21
Banff 920375	Hol.	131	6,791±97.0	2,130±30.5	1,342±30.9	64.1±0.79	3.1±0.07
Bovak 506089211	Hol.	162	8,041±115.1	2,149±34.8	1,299±34.4	55.2±0.94	2.7±0.07
Wilson 400720	Hol.	62	7,911±169.2	1,996±50.9	1,155±52.9	51.1±1.71	2.5±0.11
Vice 10910993	Hol.	59	6,599±142.4	2,264±51.4	1,465±50.8	64.4±1.53	3.6±0.12
Volt 5839901	Hol.	104	8,088±177.3	2,202±46.2	1,387±47.4	60.4±1.15	2.9±0.11
Diplomat 401497	Hol.	72	7,982±113.3	3,005±56.0	2,192±56.7	79.9±0.68	4.8±0.16
Kerry 5634653	Hol.	59	6,853±107.6	2,487±54.4	1,383±54.8	71.7±1.05	3.9±0.14
Sapphire 401799	Hol.	54	7,559±154.5	3,462±71.5	2,626±71.2	82.7±0.69	5.6±0.20
May 5573 (3/4 Hol.)	UBR	76	7,165±116.3	3,025±77.8	2,188±78.7	77.1±0.97	4.9±0.17
Start 5151 (3/4 Hol.)	UBR	55	6,536±161.2	3,263±88.6	2,427±88.3	80.1±0.98	5.2±0.21
Average for the herd		1011	7,521±36,8	2,427±15.4	1,606±11.5	65.7±0.23	3.6±0.07

Source: Own calculations.

By the lifespan evaluation, the advantage was on the side of daughters of Holstein breeders Diplomat and Sapphire and Ukrainian Red-and-White dairy May and Start, that amounted to 3,005-3,462 days. The statistically significant difference between daughters of these sires compared to the average value by herd varied from 578 to 1,035 days (P

<0.001). Among the breeders which have the highest lifespan, with the exception for two purebred Holsteins (Diplomat and Sapphire), there were two representatives of Ukrainian Red-and-White dairy breed (May and Start), indicating on the high genetic potential of the productivity of sires of Ukrainian selection crossed after Holstein breed. The term of economic use, which is represented by both absolute and relative numerical values, was indirectly related to the lifespan of animals. By the interval of economic use (***I_{eu}***) and coefficient of economic use (***C_{eu}***), the daughter offspring of bull-breeders Diplomat, Sapphire, May and Start with variability of research results within 2,188-2,626 days and 77.1-82.7% prevailed the average of experimental herd by 582-1,020 days and 11, 4-17.0%, with high reliability (P <0.001). The period of economic use was supplemented by a feature - the total number of lactations used by animals. In our studies, the variability of this indicator varied significantly, from 2.5 to 5.6 lactations. The advantage by total number of used lactations remained for daughters of Holstein breeder Sapphire. Reliable difference of the daughters of the best breeders on this trait in comparison with the average value by herd was 1.2-2.0 lactations (P <0.001). Milk production of the daughter offspring of estimated bull-breeders by the data of the first lactation showed that its indicator, especially the highest rates, did not always correlate with longevity. Among the best rated breeders, only daughters of Sapphire 401.799 had the highest yield (7.559 kg) by data of the first lactation. Studies report that milk production for the first lactation has a high repeatability with subsequent lactations, serving as an indicator of determining the breeding value of animals at an early age [11, 12, 15, 20, 25]. The evaluation of sires in terms of offspring quality was also based on the milk productivity of first-calf cows.

Table 2. Lifelong productivity of daughter progeny of bull-breeders Ukrainian Red-and-White dairy breed, x ± S.E.

Sire	n	Lifetime:			Milk yield for one:	
		milk yield, kg	yield of milk fat, kg	fat content in milk, %	day of life, kg	economic use, kg
Inhibitor	115	27,992±896.2	1,052.5±29.82	3.76±0.013	12.5±0.28	19.9±0.45
Intul	62	28,549±1440.4	1,087.7±47.27	3.81±0.023	12.4±0.46	19.5±0.65
Banff	131	25,009±404.8	932.8±13.59	3.73±0.012	11.7±0.13	18.6±0.18
Bovak	162	24,582±604.9	929.2±19.55	3.78±0.011	11.4±0.22	18.9±0.39
Wilson	62	21,719±1001.9	801.4±33.14	3.69±0.019	10.9±0.36	18.8±0.67
Vice	59	19,407±646.8	727.7±22.46	3.75±0.031	8.6±0.25	13.2±0.41
Volt	104	24,782±852.1	936.8±28.23	3.78±0.017	11.2±0.29	17.9±0.48
Diplomat	72	35,715±877.8	1,328.6±29.54	3.72±0.015	11.9±0.21	16.3±0.27
Kerry	59	26,974±850.1	1,006.1±28.47	3.73±0.020	10.8±0.26	19.5±0.34
Sapphire	54	38,811±1167.0	1,455.4±34.34	3.75±0.016	11.2±0.23	14.8±0.29
May	76	33,588±1012.7	1,289.8±33.19	3.84±0.016	11.1±0.19	15.3±0.28
Start	55	36,044±1128.8	1,376.9±36.72	3.82±0.023	11.0±0.18	14.8±0.24
Herd average	1,011	27,918±321.5	1,050.7±9.54	3.76±0.007	11.4±0.06	17.7±0.08

Source: Own calculations.

However, in our studies, the relatively high milk yields of a large number daughters of Holstein breed sires Volt (8,088 kg), Bovak (8,041 kg), Inhibitor (7,956 kg), Wilson (7,911 kg) and Intul (7,844 kg) didn't provide the appropriate indicators both in terms of length of use and lifelong production (Table 2). The highest lifelong dairy productivity was distinguished by the offspring of sires with higher indicators of life expectancy and economic use while maintaining the priority of positions. Daughters of the Holstein sire Sapphire were characterized by the highest lifetime milk yield, from which 38,811 kg of milk and 1,455.4 kg of milk fat. The next place in the ranking belonged to the daughters of the bull Start of Ukrainian Red-and-White dairy cattle. During 5.2 used lactations,

lifelong milk yield of his daughters averaged 36,044 kg and milk fat 1,376.9 kg. In the third place were daughters of the Diplomat – a sire of Holstein selection, and in the fourth place – the sire' offspring of domestic origin May, from which for 4.8 and 4.9 lactations received lifetime milk yield – 35,715 and 33,588 kg and milk fat – 1,328.6 and 1,289.8 kg., respectively. The highly reliable difference in lifetime milk yield and milk fat in the daughter offspring of these sires compared to the average indicators for the herd was 6,400-11,611 and 219.7-366.4 kg, respectively (P <0.001). The hereditary influence of sires on the fat content of daughters' milk was evidenced by a highly reliable difference of 0.15% (P <0.001) between the highest rate of 3.84% (May's daughter) and the lowest – 3.69% (Wilson's daughter). Analyzing the traits that also characterize lifelong productivity - milk production for one day of life and economic use, there is a pattern, which is that much higher yield for one day of life and productive use characterized breeding bulls in which daughter offspring differed in higher milk yields for 305 days of the first lactation, lower periods of life and economic use. These are Holstein breeders: Inhibitor, Intul, Banff, Bovak, Wilson and Kerry.

The level of coefficients of phenotypic correlations between the level of milk yield during the first lactation and type traits of longevity were presented in (Table 3).

Table 3. Relationship between milk amount for the first lactation and longevity traits of bull-breeders daughters

Sire	Breed	n	Duration:		C_{eu},%	Number lactations, pcs.
			life, days	economic use, days		
Inhibitor 402151	Hol.	115	-0.033	-0.044	0.033	-0,046
Intul 401806	Hol.	62	-0.081	-0.053	-0.125	-0,142
Banff 920375	Hol.	131	0.132	0.122	0.093	0,074
Bovak 506089211	Hol.	162	-0.009	-0.036	-0.044	-0,102
Wilson 400720	Hol.	62	0.184	0.213	0.197	0,095
Vice 10910993	Hol.	59	0.155	0.162	0.185	0,121
Volt 5839901	Hol.	104	0.113	0.122	0.156	-0,107
Diplomat 401497	Hol.	72	-0.233**	-0.227**	-0.194*	-0,224**
Kerry 5634653	Hol.	59	0.088	0.034	0.041	0,057
Sapphire 401799	Hol.	54	-0.074	-0.045	-0.077	-0,111*
May 5573 (3/4 Hol.)	UBR	76	-0.244**	-0.217**	-0.119	-0,163*
Start 5151 (3/4 Hol.)	UBR	55	0.212**	0.259**	0.225**	0,185***
Average for the herd		1,011	-0,187***	-0.216***	-0.198***	-0.145***

Source: Own calculations.

The correlation coefficients between milk yield for the first lactation and indicators of the duration of use of the offspring of sires differed in significant variability from moderate negative with life expectancy (r=-0.244; May's daughters) to positive with economic use (r=0.259; Start's daughters).

Correlation coefficients for the herd as a whole testified with a high degree of reliability that with an increase in milk yield of cows for 305 days of the first lactation, their life expectancy, duration ***(D_{eu})*** and coefficient of economic use ***(C_{eu})***, and the number of used lactations decrease by 18.7; 21.6; 19.8 and 14.5%, respectively.

The findings that high first lactation productivity led to a decrease in duration of use and didn't always guarantee high lifetime productivity was consistent with other studies on this issue [2, 8, 19]. This was also reported by studies of Holstein cattle from Serbia [17] with a correlation between first lactation and lifelong yield (r = -0.088), productive life (r = 0.0023); brown Swiss breed in Slovenia in which correlation between yield for the first lactation and productive life was moderate and negative (-0.41 ± 0.052) [15]. It was

reported [13, 18, 20] that the established positive and reliable correlation coefficients between milk amount for the first lactation and longevity traits in the daughters of estimated bull-breeders allow to use the yield of cows for the first lactation as a predictor of lifelong productivity, (Table 4).

Table 4. Relationship(r) between milk amount for the first lactation and lifelong productivity indicators of sires offspring

Sire	Breed	n	Lifetime:			Milk yield for one:	
			milk yield, kg	yield of milk fat, kg	fat content in milk, %	day of life, kg	day of economic use, days
Inhibitor	Hol.	115	0.306***	0.267*	0.045	0.441***	0,527***
Intul	Hol.	62	0.444***	0.249*	0.235	0.622***	0,659***
Banff	Hol.	131	0.356***	0.273**	-0.095	0.371***	0,596***
Bovak	Hol.	162	0.394***	0.324***	0.221**	0.442***	0,555***
Wilson	Hol.	62	0.537***	0.345**	0.373**	0.569***	0,563***
Vice	Hol.	59	0.390***	0.395**	0.126	0.369***	0,392***
Volt	Hol.	104	0.401***	0.324**	0.098	0.439***	0,432***
Diplomat	Hol.	72	0.442***	0.374**	0.107	0.337**	0,564***
Kerry	Hol.	59	0.442***	0.378**	-0.161	0.378**	0,513***
Sapphire	Hol.	54	0.498***	0.396**	0.059	0.244*	0,482***
May	UBR	76	0.403***	0.427***	0.029	0.286**	0,441***
Start	UBR	55	0.444***	0.468***	0.279*	0.285*	0,466***
Average for the herd		1,011	0,488***	0.401***	0.088	0.384***	0.421***

Source: Own calculations.

About the relationship between first lactation traits and productive longevity traits was confirmed by studies of Holsteins in North Carolina herds, according to which the genetic correlation between milk production of the first lactation and lifelong was 0.85 [9]. Canadian Holstein cows were closely correlated with the first lactation yield and most of the longevity indicators - from 0.64 to 0.92 [11]. A weaker correlation was obtained in the study of Brown cattle in Slovenia with coefficients of 0.26 ± 0.057 [15].

CONCLUSIONS

Evaluating the longevity rates of the offspring of estimated bull-breeders of different origins, we can generalize that to improve the dairy breeds of Ukraine the best genetic resources of domestic producers should be used. When using bulls from the world gene pool in the breeding process, it is advisable to take into account their longevity assessment indicators.
The high level of milk yield of the first-born cows of evaluated bulls didn't provide an increase in the indicators of the length of economic use in them, however, it will guarantee higher lifelong milk productivity.

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