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Assessment of the breeding value of Holstein black-and-white stud bulls in the Republic of Kazakhstan

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Abstract

Currently, the dairy cow industry's primary goal is to reach maximum indicators in the manufacture of high-quality goods. It is necessary to utilize high-quality animals in breeding and productive qualities to attain this goal. Numerous research and practical works have proven that stud bulls have a major impact on the genetic effect of animal stock correction: proper stud bull selection ensures maximal genetic development in animal production. Animals of the Holstein breed of various selections are used to enhance domestic black-and-white cattle (Canadian, American, Danish, etc.). The article presents the results of the assessment of stud bulls according to the Instructions in force in the Republic of Kazakhstan. As an object of research, information was used on first-calvers (daughters) who lactated in 2016-2017 in the breeding herds of the republican populations of Holstein cattle. In a comparative aspect, the analysis of the results of a study of the breeding qualities of the estimated bulls in the context of different years and in total is carried out. The necessity of applying new approaches to assessing the breeding value of stud bulls in dairy cattle breeding is established.

Keywords: breeding category; stud bulls; milk productivity; selection; efficiency.

Practical Application: It is recommended to evaluate the black-and-white Holstein cattle in the Republic of Kazakhstan according to the instructions for the bonitization of cattle.

1 Introduction

In modern conditions of development of dairy cattle breeding in general as an industry, the goal is to maximize profits, and breeding in herds is aimed at reproducing the largest number of highly productive animals for breeding in specific conditions (Altukhov et al., 2019; Gorodov et al., 2019; Panyshev & Katlishin, 2020). Among the "best" animals are those that genetically determine the possibility of obtaining the greatest profit in the established economic realities of managing both in the near future and in the future (Zheksembekovich & Dastanbekuly, 2020; Krugliak & Krugliak, 2021).

The official assessment of the breeding value of animals in dairy cattle, currently used in Kazakhstan, is carried out according to a set of breeding and productive qualities, in particular, of stud bulls, is carried out in accordance with the "Instruction on the verification of dairy and dairy-beef breeding bulls for the quality of offspring " (Abugaliyev et al., 2018; Carillier et al., 2013; Kazhgaliyev et al., 2020; Madeja et al., 2004; Pryce et al., 2015; Yelemesovich & Dastanbekovich, 2020).

The basis of this instruction is based on principles and requirements that were developed in the first half of the last century, which currently does not correspond to modern scientific approaches, first of all, the genetics of quantitative traits, or the current socio-economic conditions of the agro-industrial complex of the republic (Krasota et al., 1990; Lauvie et al., 2008; Mulder et al., 2006). This fact casts doubt on the objectivity of a comprehensive assessment currently used in the breeding of dairy and dairy meat stud bulls.

2 Materials and methods

The research material was the indicators of phenotypic traits of milk productivity of first-calvers (level of milk yield, fat and protein content in milk, milk fat and protein yield) of Holstein black-and-white dairy cattle breed, obtained from the republican database of the information-analytical system of the Republic of Kazakhstan for 2016-2017 years (Ionitescu et al., 2019; Zheksembekovich et al., 2020). Assessment of the breeding value of stud bulls by productive indicators of daughters was carried out on the basis of the existing Instructions (Berry et al., 2019; Baimukanov et al., 2021). Analysis of the results of the study was carried out using generally accepted methods of statistical processing of data used in biological research (Bourdon, 1998; Druet et al., 2001; Abugaliyev et al., 2019; Chindaliyev et al., 2021; Bekenov et al., 2019; Merkuryev & Shangin-Berezovsky, 1983; Sushkov, 2021; Van Vleck, 1974; Zelenkov et al., 2019;).

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3 Results

Currently, in the practice of breeding work with dairy cattle of the agro-industrial complex of Kazakhstan, the verification of dairy bulls for the quality of offspring is carried out according to the Instructions officially approved by the scientific and technical council of the Ministry of Agriculture of the Republic of Kazakhstan (Babich et al., 2019; Abugaliyev et al., 2021). This normative legal act involves the comparison of phenotypic indicators of the offspring of the tested bulls with the corresponding indicators of their peers on the basis of the "daughter-peers" principle (Bourdon & Brinks, 1986; Spangler, 2003). In each household, the peers of the daughters of the tested bull are descendants of other studs; however, the dates of birth and age of the first calving of daughters and peers should not exceed six months. The main requirement for official recognition of the bull estimated is the presence of at least 15 daughters who have completed 305 days of the first lactation.

Based on data on the initial number of animals covered in the population, the breeding value of the stud bulls was estimated by the milk productivity of their daughters according to the official methodology. The general characteristics of the indicators covered in the studies are given in Table 1.

In general, for the entire analyzed period, 30 stud bulls received an assessment of breeding value (16 animals – in 2016 and 14-in 2017), and the latter had their breeding value index updated. The average number of daughters (considering the overestimation) per tested breeder for the total evaluation period was 59 heads and almost four times exceeded the threshold value (15 heads), which indicates a fairly good organization of bull testing in the population. Table 2 shows the average indices of breeding value of stud bulls for different years and for the total period.

It was found that in 2016, the average data of the daughters of the tested stud bulls and their peers were almost at the same level for all breeding characteristics. On average, the bulls estimated for the first time were almost equal in their genetic value to those already used stud bulls, assessed and selected earlier during mass reproduction of breeding stock in the population. In 2017, the situation changed somewhat: the daughters of the bulls evaluated for the first time surpassed their peers in milk yield (by 110 kg) but were slightly inferior to them in terms of fat content in milk (by 0.02%) and protein (by 0.03%).

The given average indicators only describe in general terms the array of daughters and their assessed fathers themselves. A more detailed description is presented in Table 3, which shows the results of assessing stud bulls for milk productivity of offspring, considering their distribution by category (improvers, neutral, and degraders) (Jankowska-Huflejt et al., 2011). In accordance with the theoretical distribution (Gauss curve), the ratio of observations "improver – neutral – degrader" should approximately correspond to 1:2:1. As the results of the assessment of bulls according to official instructions show, neither in 2016 nor in 2017, this ratio was observed: in 2016, it was 6:5:5, and in 2017-3:3:1, which in turn calls into question the methodological foundations laid in the document used for determining the breeding value. This situation can often occur in

Table 1. Phenotypic indicators of milk productivity of daughters assessed according to official instructions of stud bulls.

Years	Number of estimated stud bulls, animals		The average number of daughters per 1 bull, animals	The average productivity of the daughters of estimated stud bulls				
				Milk yield, kg	Fat, %	Fat, kg	Protein, %	Protein, kg
2016	16		36	4936	3,80	186,7	3,28	162,0
2017	28		44	5631	3,95	221,1	3,38	189,5
	including	first estimated-14	45	5761	3,94	225,4	3,37	193,0
		overestimated -14	43	5481	3,96	216,1	3,40	185,5
2016-2017	30		59	5482	3,92	214,0	3,37	183,7

Table 2. Assessment results of bulls for milk productivity of daughters based on official instructions.

Years	Number of estimated stud bulls, animals		The average number of daughters per 1 bull	Average indicators of the breeding value of stud bulls				
				Milk yield, kg	Fat, %	Fat, kg	Protein, %	Protein, kg
2016	16		36	-8,82	-0,01	-0,98	-0,01	-0,72
2017	28		44	+70,64	-0,02	+2,07	-0,02	+1,65
	including	first estimated -14	45	+109,73	-0,02	+3,29	-0,03	+2,43
		overestimated -14	43	+25,53	-0,02	+0,66	-0,01	+0,74
2016-2017	30		59	+45,53	-0,02	+1,12	-0,02	+0,82

Table 3. Assignment of bulls by breeding value category.

Year	Category of bulls	Number of bulls, animals	Number of daughters, animals	Average milk productivity index of the daughters of the assessed stud bulls				
				Milk yield, kg	Fat, %	Fat, kg	Protein, %	Protein, kg
2016	Milk yield and fat improver	2	79	+183,5	+0,04	+8,5	+0,015	+6,85
	Milk yield improver	4	122	+535,7	-0,01	+19,2	-0,035	+16,75
	Fat improver	-	-	-	-	-	-	-
	Neutral	5	170	-6,4	-0,02	-2,0	-0,016	-1,72
	Degraders	5	214	-523,8	-0,01	-19,9	+0,010	-16,70
Total in 2016		**16**	**585**			-		
2017	First estimated stud bulls							
	Milk yield and fat improver	1	27	+399	+0,01	+15,8	-0,01	+13,4
	Milk yield improver	4	298	+580,4	-0,07	+18,2	-0,06	+16
	Fat improver	1	18	+105	+0,07	+8	-0,08	-1,5
	Neutral	6	262	-196,1	+0,02	-6,1	+0,018	-5,48
	Degraders	2	74	-291,5	-0,09	-14,3	-0,045	-11,25
	Total	**14**	**679**			-		
	Overestimated stud bulls							
	Milk yield and fat improver	-	-	-	-	-	-	-
	Milk yield improver	5	115	+325,5	-0,07	+9,8	-0,047	+9,35
	Fat improver	1	48	+19	+0,03	+1,3	+0,01	+1,2
	Neutral	8	395	-123,6	+0,01	-3,9	+0,01	-3,6
	Degraders	-	-	-	-	-	-	-
	Total overestimated	**14**	**558**			-		
Total in 2017		**28**	**1237**			-		
2016-2017	Milk yield and fat improver	2	98	+311,0	+0,01	+12,2	-0,005	+10,45
	Milk yield improver	10	574	+394,4	-0,05	+12,37	-0,056	+10,55
	Fat improver	1	18	+105	+0,07	+8,0	-0,08	-1,5
	Neutral	14	967	-149,1	+0,01	-5,1	+0,010	-4,14
	Degraders	3	123	-405,6	-0,06	-17,0	-0,027	-14,13
Total in 2016-2017		**30**	**1780**			-		

practice, when both descendants of still unvalued and daughters of already assessed bulls are selected as peers for the daughters of the tested individual (moreover, in an indefinite ratio, each time in a different way). As a result, the tested bulls may be in unequal conditions, which may entail the incorrect assignment to the proband of the category of breeding value. Confirmation of this thesis is the results of a reassessment of stud bulls in 2017.

First, the distribution of genotypes by category changed dramatically and amounted to 6:8:0 (in total, 14 bulls out of 16 were re-evaluated).

Second, at least three of the fathers recognized in 2016 as degraders continued to be used in the reproduction of genetic material in the population after being tested, which is, although not critical, but a negative element of the organization of the breeding scheme in the population in question. Third, in certain situations, the assessed and assigned to certain category bulls had indices of breeding value less than other stud bulls assigned to a lower category.

For example, in 2017, a genotype with an index of + 76 kg of milk was assigned to the category of "milk yield improver among stud bulls that" for the first time received breeding certification, while a bull assigned to the category of "fat improver" (i.e., it turned out to be neutral for milk yield) had an index of +105 kg of milk. The same situation was observed when comparing stud degraders, whereas the sperm of such bulls should be disposed of from the breeding enterprises and neutral bulls. So, in 2017, an individual with an index of 185 kg of milk was assigned to the first of these categories; along with this, a bull with the category "neutral" had an index significantly lower (-606 kg of milk).

It is characteristic that out of five stud bulls classified as a "degrader" in 2016 with significant negative indices for milk yield (from -295 kg to -921 kg of milk), four bulls increased their category when revalued in 2017 and were classified as neutral, i.e., allowed for mass reproduction of genetic material in the population.

It should also be noted that according to the current Instructions, bulls are assessed for the quality of the offspring only once in their lifetime and at the same time receive a lifelong breeding category, and their semen can be used for an unlimited and unregulated period of time, with a properly organized selection system, indicators of estimated stud bulls should gradually decline.

Therefore, to ensure a systematic increase in the genetic potential of animals in the population, there is an urgent need for constant adjustment of the assessment of breeding qualities of stud bulls as their indices are refined. The above disadvantages are not considered in the official instructions, which, in turn, negatively affects the rate of genetic improvement of animals in the population.

4 Conclusion

The study of relationships between technical factors that enable intense output is an important topic in the world of dairy cattle farming. In general, technological components must be linked to contemporary scientific discoveries and take into consideration industry best practices. The amount of milk productivity has been proven to be genetically conditioned, yet these indicators are directly reliant on production circumstances established during the commercial usage of cows. The method of livestock management is one of the most important aspects of technology in Russia: the majority of enterprises (roughly 95%) use the tied-up method, which has the obvious advantage of allowing for regular feeding and facilitating animal control and service; the other uses the cubicle (industrial technology) method (about 5%).

Based on the analysis, it can be concluded that the "Instruction on the verification of dairy and dairy-beef breeding bulls for the quality of offspring" adopted in 2007 in the Republic of Kazakhstan has significant methodological flaws and is not fully optimized from the point of view of planning and organizing its implementation in the practice of dairy cattle breeding in Kazakhstan.

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