Use of Holstein bulls in improvement of black pied cattle

N L Ignatieva*, I V Voronova, E Yu Nemtseva and G M Toboev

Department of General and Private Animal Science, Chuvash State Agrarian University, 29 K Marx Street, 428000, Cheboksary, Russian Federation

*E-mail: ignatieva_natalia@edu.academ y21.ru  https://orcid.org/0000-0003-1845-1443

Abstract. Sires play an important role in improvement of productive qualities of bred livestock. Most researchers and breeders estimate their impact to be at least 90%. In order to evaluate the results of using different Holstein breeding bulls, we compared the productivity of their offspring with the average values for all bulls. The following methods of variation statistics were used: observation, data grouping, and correlation analysis. It was found that the best are the descendants of the bull Estuary 2186 of the Montwick Chieftain line. Besides, Liman 2186 bull’s daughters excelled in high milk fat content – 4.46%. Daughters of Punch 2748 bull of Pabst Governor line were the best in protein content of milk (3.27%). Daughters of Liman 2186 bull had the highest fat and protein yield during 305 days of lactation. It was established that the direction and value of correlation between the main features of milk yield of cows of different lineages have a rather high degree of variation. Presence of positive genetic correlation between milk yield and protein content in milk in some lines of animals enables breeding cows by two traits simultaneously (milk yield and protein content in milk).

1. Introduction

The country’s food security always receives a lot of attention. Providing country’s citizens with food products is the main task faced by modern cattle breeding [1, 2]. During the recent decade, country’s dairy husbandry has been characterized with active integration of industrial technologies. Therefore there remains the need in high-yield cattle and arises an acute need in dairy cattle well adapted for such technologies. Besides, breeding of such cattle will make it possible to eliminate Russia’s “breeding” dependence on import of breeding stock and sires. The black pied cattle population takes the dominant position by the dairy cattle numbers in the country – 51.01% (1,354,400 heads of cattle), it is followed by Holsteins – 19.9% (524,600 heads of cattle) [3].

Breeding and productive traits of dairy cattle depend on many factors [4-7]. Among them, the genotype of animals takes an important place [8, 9]. Practical experience in dairy cattle husbandry shows that sires play a great role in improvement of economic traits of bred cattle. Researchers and practicing breeders estimate the impact of sires to be at least 90% [10]. Therefore the task of detection and wide use of semen of sires meeting corresponding requirements for use in certain economic conditions is quite relevant for breeders.

At present active works on improving the genetic potential of Russian breeds are in progress. An important direction in the works both with the black pied breed and other ones is improvement of productive traits of cattle. Holstein sires are widely used for these aims. They are used for creating new dairy breeds and intrabreed types of cattle [11-15]. Also, lines of bulls have been bred in the breed, the offspring of which are distinguished by a high quality composition of milk - fat-milk and protein-milk
content. Holstein breed is rightly considered to be the breed with the highest milk yield and has a number of other evident advantages [16]. However, there are opinions that its use for improvement of other breeds should be restricted. The highly-specialized Holstein cattle is often characterized with body composition delicacy, rather low adaptation capabilities, high dependence on the feeding and housing level, reduction of high-yield abilities. At the same time in countries with developed dairy husbandry of great importance is estimation and selection of sires by protein content of milk as a special direction in practical dairy cattle breeding [17-19]. It is generally known that the fractional composition of milk protein is a genetic factor [20-21]. Despite this Russia continues to import semen of foreign Holstein bulls.

Against this background, the problem of developing new methods of selection and selection that will allow dairy cattle to realize the inherent genetic potential of productivity to the maximum extent becomes very urgent. Therefore, the evaluation of lines and breeding bulls will allow to develop methods for improving dairy cattle and creating breeding highly productive herds of dairy cattle [22].

The purpose of the study is to estimate the results of use of Holstein sires in improvement of black pied cattle in the black pied breeding unit.

2. Methodology
The study was carried out in the dairy herd of the black pied cow breeding unit of JSC «Agrofirma «Kusnar» (Tsivilsky Region, Chuvash Republic, Russia). There are 370 heads of cattle in the herd of this organization. The average milk yield of 250 dairy cows made up 7,062 kg of milk with 4% fat content. The object of the study was 100 mature black pied cows with completed lactation that have over 90% blood level by the upgrading Holstein breed in their genotype. The material of the study was breeding cards of cows (2-MOL form) containing all cow data and other documents of zootechnical and breeding records of the organization. The farm uses the software “SELEX – Dairy Cattle” to analyze the data of primary zootechnical and breeding records. The program of the IAS “Selex. Dairy cattle” was developed by LLC «Regional Center for information support of livestock breeding Leningrad region «PLINOR» (Russia). Analysis of the right side of the cows’ lineage enabled revealing the leading lines of the herd cows. Dairy productivity of cows was determined on the basis of monthly data of control milk yields with the determination of the qualitative composition of milk. The content of fat and protein in milk was determined in the Prifermskaya dairy laboratory using an ultrasonic milk analyzer "Clover-2" (Biomer, Russia). After switching on, the analyzer warmed up for 5 sec. A sample of milk with a temperature of 20-22°C was poured into the sampler to a level (5-7) mm below its upper edge. After a minute, the sample measurement ended; the device beeped, and the measured values of the indicators were displayed alternately on the indicator. The lower indicator light indicated which indicator was being displayed at the moment. The limits of measurement error of fat and protein content were 0.06 and 0.15%, respectively. The amounts of milk fat and protein (in %) were calculated by multiplying the amount of milk, expressed in kilograms, by the fat or protein content in it.

The influence of origin on the dairy productivity of cows was studied by distributing animals into gradations according to the studied trait. All digital material is processed by the method of variation statistics using Microsoft Excel. The assessment of the reliability of the differences was carried out according to the Student's reliability criterion.

The dairy cows of the herd were divided into four experimental groups, the formation of which by the method of balanced analogue groups with account for origin, blood level and age. The first group included cows of Pabst Governor line, the second one – Reflection Sovereign line, the third one – Wis Burke Ideal line, the fourth one – Montvic Chieftain line. Within each line the animals were grouped by origin on the bull side. The analysis encompassed daughters of 13 Holstein sires: Grek 1964, Aly 2490 and Punch 2748 of Pabst Governor line; Elisey 164, Eskort 1329, Tuman 16, Labaz 1810 and Tsitron 40 of Reflection Sovereign line; Merinit 821153 and Roy 811 of Wis Burke Ideal line; Vals 1496, Liman 2186 and Legend 3491 of Montvic Chieftain line.

The offsprings of different sires were compared by productivity of their offsprings with the average values by all bulls.
The following methods of variation statistics were used to achieve the set aim: observation, data grouping, correlation analysis. All the digital material obtained in the course of study was processed by means of biometry methods, which is required for justification of the reliable conclusion on the studied issue. The arithmetic mean, error of arithmetic mean, test of validity and level of significance were calculated. The interdependence between the traits in the experimental groups was studied by the correlation coefficient (r).

The significance of differences between series of values was determined based on the value of Student t-test for those levels of confidence (statistical) significance. The differences were believed to be significant with 5% significance level (P<0.05).

3. Results and discussion

The milk yield of cattle is a complex trait including quantitative and qualitative parameters the values of which depend on many factors. Comparative analysis of milk yield of cows depending on their lineage makes it possible to adjust breeding works for the herd and efficiently use the best genotype.

Comparative estimation of sires requires characterizing their daughters by milk yield. The data of milk yield, fat content and protein content of cows of different genotypes are given in table 1.

| Sires          | Number, heads | Milk yield for 305 days of lactation, kg | Fat content, % | Protein content, % |
|---------------|---------------|----------------------------------------|----------------|--------------------|
|               |               | Pabst Governor line                     |                |                    |
| Grek 1964     | 6             | 7508±362                               | 4.19±0.06      | 3.16±0.06          |
| Aly 2490      | 19            | 6650±346                               | 4.25±0.03      | 3.17±0.01          |
| Punch 2748    | 3             | 5994±840.2                             | 4.33±0.08      | 3.27±0.03          |
| Line average  | 30            | 6817±258                               | 4.24±0.03      | 3.18±0.02          |
|               |               | Reflection Sovereign line              |                |                    |
| Elisey 164    | 4             | 7520±540.3                             | 4.24±0.13      | 3.19±0.05          |
| Eskort 1329   | 6             | 6775±283.9                             | 4.34±0.05      | 3.17±0.02          |
| Tuman 16      | 12            | 7691±254.5                             | 4.23±0.05      | 3.18±0.02          |
| Labaz 1810    | 3             | 8279±474.9                             | 4.29±0.10      | 3.14±0.06          |
| Tsitron 40    | 5             | 7241±692.5                             | 4.26±0.07      | 3.17±0.04          |
| Line average  | 35            | 7466±168.6                             | 4.29±0.03      | 3.17±0.01          |
|               |               | Wis Burke Ideal                        |                |                    |
| Merinit 821153| 7             | 8253±457.8a                            | 4.19±0.04a     | 3.18±0.02          |
| Roy 811       | 7             | 6310±540.2                             | 4.20±0.05      | 3.17±0.04          |
| Line average  | 19            | 7,228±353.9                            | 4.25±0.04      | 3.16±0.02          |
|               |               | Montvic Chieftain line                 |                |                    |
| Vals 1496     | 3             | 7,950±177.5b                           | 4.32±0.10      | 3.19±0.03          |
| Liman 2186    | 3             | 8,725±460.2                             | 4.46±0.04c     | 3.18±0.02          |
| Legend 3491   | 5             | 7,837±1006.3                           | 4.21±0.06      | 3.19±0.03          |
| Line average  | 16            | 7,623±375.8                            | 4.36±0.05      | 3.17±0.02          |
| Herd average  | 100           | 7,252±134.1                            | 4.28±0.02      | 3.17±0.01          |

aP< 0.05, bP<0.01, cP< 0.001

Montvic Chieftain line was the best, its yield was 7,623 kg, which is 371 kg more comparing to the herd average value. Besides, Montvic Chieftain line cows are characterized with the highest fat content – 4.36 %, which exceeded the average herd fat content in milk by 0.08 %. Pabst Governor line cows were the best in terms of protein content in milk (3.18 %), which is 0.01 % more comparing to the herd average value. Protein content in milk of Montvic Chieftain line cows was on the level of 3.17% (table 1). Analysis by sires shows that the best milk yield during 305 days of lactation was demonstrated by daughters of Liman 2186 bull of Montvic Chieftain line, their yield was 8725 kg, which is 1473 kg
more comparing to the average values for all bulls (P<0.01). The yield of daughters of Labaz 1810 of Reflection Sovereign line and Merinit 821153 of Wis Burke Ideal line were also high (> 8,000 kg). Besides, Liman 2186 bull’s daughters had a high fat content in milk – 4.46 %, which exceeded the average fat content in milk in the herd by 0.18 % (P<0.001). The best protein content in milk during 305 days of lactation was demonstrated by daughters of Punch 2748 bull of Pabst Governor line (3.27 %), which is 0.1 % more comparing to the average values for all bulls (with P<0.01). Moreover, daughters of Punch 2748 bull had a good combination of main milk components (43.3 % fat, 3.27% protein). Daughters of Vals 1496 bull of Montvic Chieftain line were notable for a rather high milk yield during 305 days of lactation – 7950 kg of milk with 4.32 % fat content and 3.19 % protein content.

Table 2 shows data about fat and protein in milk of daughters of different bulls. Liman 2186 bull was characterized with its daughters’ highest milk fat yield during 305 days of lactation (388.5 kg). The gain in the milk fat quantity with respect to the average value of all bulls’ daughters made up 78.5 kg, or 20.2 % (P<0.001). Labaz 1810 and Merinit 821153 bulls’ daughter’s milk fat yield was a little lower and made up 354.6 and 346.3 kg, respectively. Liman 2186 bulls’ daughters also had a high milk protein yield – 277.9 kg, which is 47.8 kg comparing to the average values of all bulls’ daughters (P<0.01).

A high milk protein yield was demonstrated by Merinit 821153 and Labaz 1810 bulls’ daughters. The lowest protein yield per 100 g of fat during 305 days of lactation was shown by Liman 2186 bull’s daughters – 71.4 g, which is 2.9 g less comparing to values of all bulls. The highest protein yield per 100 g of fat was demonstrated by Legend 3491 and Merinit 821153 bulls’ daughters – 75.9 and 75.8 g, respectively. Liman 2186 bulls’ daughters have a valuable trait. Their milk yield with milk protein yield of 277.9 kg and protein content of 3.18% was 8,725 kg (table 2).

Table 3 contains calculations of phenotypic dependence of milk yield parameters of cows of different lineages. It was established that the nature and magnitude of interrelation between main traits of milk yield have a high variability depending on lineages of cows. The phenotypic correlation between the milk yield and fat content in milk of cows irrespective of their origin is negative and very low. It has the lowest value at the level of -0.04 in Montvic Chieftain line. As a result, selection of cows by milk yield will be accompanied with insignificant negative changes in fat content in milk. Presence of positive,
although low, genetic correlation between milk yield and protein content in milk of cows of Pabst Governor, Montvic Chieftain and Wis Burke Ideal lines shows that selection of cows by milk yield only will not have a high positive effect. The relation between these parameters in Reflection Sovereign line is very weak, negative (-0.17). Selection of cows by fat content will result in reduction of protein content in milk in three lines bred in the farm: Reflection Sovereign, Wis Burke Ideal and Montvic Chieftain (the correlation coefficient fluctuates within the range from 0.18 to 0.53).

Table 3. Phenotypic dependence of cows’ milk yield parameters.

| Line              | Milk yield, kg – fat content, % | Milk yield, kg – protein content, % | Fat content, % – protein content, % |
|-------------------|-------------------------------|-----------------------------------|-------------------------------------|
| Pabst Governor    | -0.20±0.19                    | 0.13±0.19                         | 0.01±0.19                           |
| Reflection Sovereign | -0.11±0.20                   | -0.17±0.20                        | -0.53±0.17 (P< 0.01)               |
| Wis Burke Ideal   | -0.29±0.23                    | 0.14±0.24                         | -0.18±0.24                         |
| Montvic Chieftain | -0.04±0.27                    | 0.22±0.26                         | -0.41±0.24                         |
| Herd average      | -0.11±0.11                    | 0.09±0.11                         | -0.26±0.10                         |

Thus, it was revealed after comparative analysis of cows of different lines by milk yield that the highest milk yield figures were demonstrated by cows of Montvic Chieftain line. Cows of Reflection Sovereign and Wis Burke Ideal lines were characterized with medium yield values. It was revealed in estimation of sires by their daughters’ milk yield that the highest milk yield figures were shown by daughters of Liman 2186 bull of Montvic Chieftain line. Daughters of Labaz 1810 of Reflection Sovereign line and Merinit 821153 of Wis Burke Ideal line also had high yields. These data indicate the feasibility of insemination of black-and-white cows with Holstein bulls [22-23]. Line breeding is the most reliable way to improve existing and newly created breeds.

4. Conclusion
With the aim of improving productive qualities of cattle in the farm it is recommended to make the best use of sires with a high breeding value that enable implementation of the genetic potential manifesting itself in their offsprings, by targeted selection and breeding work with the herd. To increase effectiveness of selection breeding and selection for milk yield improvement should be done with account for the revealed correlations.

The results of the research can be used in the planning of breeding work, the development of a program for the qualitative improvement of black-and-white cattle. This will also allow us to move on to the creation of a new intra-breed type of black-and-white breed animals, combining the maximum of positive qualities of black-and-white and Holstein breeds.

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