Evaluation of sires with respect to production of their daughters and proportion of Holstein blood

M V Semkiv
Yaroslav-the-Wise Novgorod State University, 41, ul. B. St. Petersburgskaya, Veliky Novgorod, Russian Federation

E-mail: mikhail.semkiv@novsu.ru

Abstract. One of the best domestic dairy breeds is black-motley breed. At the same time, the Holstein breed has been one of the most highly productive for a long time. All world records for milk production were set by the Holstein breed. Moreover, it is very demanding in terms of management. In current conditions of the dairy cattle development, the semen of Holstein sires is still being used to increase the milk production of black-motley cows. Until today, there is no consensus on the optimal proportion of blood of the improving breed. The paper analyzes and evaluates the production of the daughters of sires depending on the proportion of blood of the Holstein breed. As a result, it was found that sires of Holstein lines have a positive effect on the production qualities of the black-motley breed, which ultimately leads to an increase in milk production. At the same time, in order to further improve the breeding and productive qualities of cows in herds, it is necessary to use sires assessed by the quality of the offspring, which are improvers in terms of milk yield and milk fat content. Consistent implementation of all technological solutions should be a fundamental factor in realization of the genetic potential.

1. Introduction

World experience of dairy farming and many researchers, including T. Yin et al. [1], J. Friedrich et al. [2], O. Hanus et al. [3], and L. P. Semkiv et al. [4], confirmed that both optimization of the conditions of cow keeping and feeding and evaluation of sires by the production of their daughters with respect to blood proportion of the improving breed are required to increase the production of dairy cows and their genetic potential.

It should be noted that for a long period the Holstein breed [5, 6, 7] has been one of the most productive breeds. All world records for milk production were set by the Holstein breed. At the same time, it is very demanding in terms of management.

The ongoing research to increase the blood proportion of the improving breed in black-motley cattle requires a scientific and competent approach to the following technological solutions: directed rearing of young replacement animals, balanced nutrition, resource-saving forage production [8, 9], veterinary services and housing conditions. A number of authors assert [10, 11] that a new generation of specialists is required, since their insufficient qualification is the main obstacle to transition to a new technological system, introduction of innovations in dairy production, including active use of information and analytical systems in sire evaluation.

Along with this, the improvement of the genealogical structure of the black-motley breed on pedigree farms [12] on the territory of the region should be carried out through the use of high-quality sires.
At the same time, a professional and competence-based approach will ensure full realization of the genetic potential of dairy cattle. In improving breeding qualities of animals, focus should be placed on sires, as the success of selection largely depends on the bull, its breeding value and pedigree. Appropriate technological conditions that satisfy physiological needs of the animal and an increased proportion of blood of the improving breed will increase its productive qualities.

2. Objects and methods of study
The object of the study was a herd of black-motley cattle and sires that have offspring in the herd of Rossiya APC in 2014–2019. The genealogical structure of the herd is presented, sire bulls are analyzed by the production of their daughters, depending on the proportion of Holstein blood.

In the study, the authors employed general scientific approaches – synthesis, analysis, abs methods of statistical observation, dynamic comparison, structural analysis, correlation-regression analysis, and methods of tabular reflection of empirical data.

Theoretical analysis of sources, publications by foreign authors [1, 2, 3, 5, 6, 7], was chosen as one of the methods to evaluate sire bulls by the production of their daughters, depending on the proportion of Holstein blood and to identify the most promising cows for further reproduction of the herd in conditions of the studied farm.

3. Results and discussion
The study showed that Novgorod region employs a rotational system utilizing Holstein sires and black-motley bulls of Dutch origin in order to breed animals of new genotypes that combine high milk production and effectiveness of the Holstein breed, as well as adaptability to the local production conditions of the black-motley breed.

Rossiya APC is engaged in dairy cattle breeding and raises black-motley cattle with different proportion of Holstein blood. Analysis and evaluation of zootechnical data showed that the average annual milk yield based on the results of production activities in 2019 amounted to 5306 kg of milk per cow, which is by 18% higher than that noted in 2018. To improve the breeding and productive traits of cattle, bulls of domestic selection and Belarusian sire bulls were used on the farm.

In addition, the genealogical structure of the herd in Rossiya APC develops with regard to the results of using bulls of different lines. Consequently, formation of the modern genealogy of the cattle herd in recent years has been affected by bulls of Holstein (51.1% of Sealing Trajun Rokit and 16.5% of Montvik Chieftain), Dutch and Swedish lines (table 1).

| Table 1. Genealogical structure of broodstock according to the line. |
|---------------------------------------------------------------|
| Name, brand and number or inventory number of the line progenitor | Inventory number and name of the bull sire | Total number of broodstock, heads | Including cows, heads |
|---------------------------------------------------------------|-----------------------------------------------|---------------------------------|--------------------|
| Vis Back Ideal 1013415 | 376 Guffi | 1 | 1 |
| | 25 Bugai | 6 | 6 |
| Total in the line: | | 7 | 7 |
| Montvik Chieftain 95679 | 600132 Biser | 9 | 9 |
| | 10480 Debut | 127 | 127 |
| | 1971 Kovboi | 13 | 13 |
| Total in the line: | | 149 | 149 |
| Reflection Sovereing 918998 | 277 | 1 | 1 |
| | 414 | 1 | 1 |
| | 425 Potap | 5 | 5 |
| | 600145 Frukt | 5 | 5 | 4 |
Table 2 shows sires that have the largest number of broodstock in the study period. These tables indicate that Lord 835 is the best sire in terms of milk production of its daughters in first lactation (+873 kg of milk). In second lactation, the highest milk production rate (+1,067 kg) was observed in daughters of Debut 10480; however, milk protein content decreased by 0.06%. At the same time, according to the results of three lactations and older, daughters of Debut 10480 exhibited a decrease in milk production by 506 kg.
Table 2. Results of evaluation of the use of bull sires.

| Inventory number | Name       | Total number of heads | 1st uncompleted lactation | Last completed lactation |
|------------------|------------|-----------------------|---------------------------|-------------------------|
|                  | Bull sire  |                       | Milk yield 100 days, kg   | Heads                   |
|                  |            |                       | Milk yield, kg            | Fat, kg                 |
|                  |            |                       | Fat, %                    | Protein, %              |
|                  |            |                       | +/- to peers              |                         |
|                  |            |                       | Heedst                   |                         |
| 10480            | Debut      | 126                   | 4619                      | 175                     |
|                  |            |                       |                           | 3.78                    |
|                  |            |                       |                           | 2.88                    |
|                  | 500219     | 95                    | 4521                      | 170                     |
|                  | Trostnik   |                       |                           | 3.76                    |
|                  |            |                       |                           | 2.98                    |
|                  | 500239     | 32                    | 4550                      | 172                     |
|                  | Brussel    |                       |                           | 3.77                    |
|                  |            |                       |                           | 2.96                    |
|                  | 600227     | 43                    | 4234                      | 161                     |
|                  | Evcalipt   |                       |                           | 3.81                    |
|                  |            |                       |                           | 2.93                    |
|                  | 600232     | 48                    | 4416                      | 166                     |
|                  | Ekzotik    |                       |                           | 3.77                    |
|                  |            |                       |                           | 2.97                    |
|                  | 835        | 24                    | 5289                      | 200                     |
|                  | Lord       |                       |                           | 3.78                    |
|                  |            |                       |                           | 2.87                    |
|                  | 10607      | 24                    | 873                       | 33                      |
|                  | Mudriy     |                       |                           | -0.01                   |
|                  |            |                       |                           | -0.06                   |
|                  | 600222     | 24                    | 4227                      | 161                     |
|                  | Magnat     |                       |                           | 3.81                    |
|                  |            |                       |                           | 2.93                    |

Table 2. continued.

| Heads | Milk yield, kg | Fat, kg | Fat, % | Protein, % | +/- to peers | Heads | Milk yield, kg | Fat, kg | Fat, % | Protein, % | +/- to peers |
|-------|----------------|---------|--------|------------|--------------|-------|----------------|---------|--------|------------|--------------|
| 13    | 14             | 15      | 16     | 17         | 18           | 19    | 20             | 21      | 22     | 23         |              |
| 28    | 5608           | 211     | 3.76   | 2.84       | -0.06        | 4899  | 186            | 3.81    | 2.92   | 81         |              |
| 39    | -428           | 168     | 3.79   | 2.91       | 1            | -783  | 162            | 3.83    | 2.92   | 86         |              |
| 0     | 0              | 0       | 0      | 0          | 0            | 0     | 87             |          |        |            |              |
| 53    | -396           | -15     | 0.01   | 0.03       | 3            | 60    | -2             | -0.08   | 0.08   | 82         |              |
| 0     | 0              | 0       | 0      | 0          | 0            | 0     | 90             |          |        |            |              |
| 20    | 4768           | 181     | 3.80   | 2.89       | 16           | 4670  | 178            | 3.81    | 2.90   | 78         |              |
| 7     | 5052           | 193     | 3.82   | 2.88       | 6            | 5114  | 192            | 3.76    | 2.97   | 84         |              |

To assess milk production of cows in first, second and third lactation, quantitative and qualitative indicators and live weight of animals were studied. Analysis of sampling data and data from table 3 revealed a positive tendency of increased milk yield in Holsteinized cows as the pedigree index increases to 75%. This is clearly seen in Musket 600232 sire of the Sealing Trijun Rockit line and Debut 10480.
sire of the Montvik Chieftain line. At the same time, a decreased production was noted for Exotica 600232 sire. The analyzed indicators of milk fat and protein content, and live weight of cows show no tendency to increase or decrease when the proportion of Holstein blood changes.

Table 3. Description of bulls by the production of daughters and by the proportion of Holstein. Blood.

| Lactation, proportion of blood of the improving breed | Mushket 600232 | Ekzotik 600243 |
|-----------------------------------------------------|----------------|----------------|
|                                                     | Heads | Milk yield, kg | Fat, % | Protein, % | Live weight, kg | Heads | Milk yield, kg | Fat, % | Protein, % | Live weight, kg |
| 1 lact. to 50%                                       | 54    | 4224           | 3.8    | 2.92       | 520             | 12    | 4483           | 3.7    | 2.97       | 530             |
| 51-75%                                               | 65    | 4225           | 3.8    | 2.93       | 519             | 4     | 3957           | 3.7    | 2.93       | 530             |
| 76-88%                                               | 8     | 4239           | 3.8    | 2.93       | 512             |       |                |         |            |                 |
| 89 and higher                                        |       |                |        |            |                 |       |                |         |            |                 |
| 2 lact. to 50%                                       | 26    | 4325           | 3.8    | 2.93       | 522             |       |                |         |            |                 |
| 51-75%                                               | 21    | 4594           | 3.7    | 2.88       | 524             |       |                |         |            |                 |
| 76-88%                                               | 5     | 4825           | 3.7    | 2.89       | 515             |       |                |         |            |                 |
| 89 and higher                                        |       |                |        |            |                 |       |                |         |            |                 |
| 3 lact. to 50%                                       | 2     | 5057           | 3.7    | 3          | 534             |       |                |         |            |                 |
| 51-75%                                               | 1     | 5107           | 3.7    | 2.98       | 540             |       |                |         |            |                 |
| 76-88%                                               |       |                |        |            |                 |       |                |         |            |                 |
| 89 and higher                                        | Debut 10480 |                |        |            |                 | Mudriy 10607 |                |         |            |                 |
| 1 lact. to 50%                                       |       |                |        |            |                 |       |                |         |            |                 |
| 51-75%                                               |       |                |        |            |                 |       |                |         |            |                 |
| 76-88%                                               |       |                |        |            |                 |       |                |         |            |                 |
| 89 and higher                                        |       |                |        |            |                 |       |                |         |            |                 |
| 2 lact. to 50%                                       | 13    | 5120           | 3.7    | 2.86       | 524             | 5     | 5127           | 3.8    | 2.88       | 530             |
| 51-75%                                               | 9     | 5313           | 3.7    | 2.86       | 536             |       |                |         |            |                 |
Obviously, a positive trend in realization of the genetic potential in case of the increased proportion of Holstein blood will contribute to consistent implementation of all technological solutions. At the same time, to further improve breeding and productive traits of cows in the herd, bulls with improved genetics should be used to produce the offspring with increased milk yield, and milk fat and protein content.

4. Conclusion
At the present stage of development of dairy cattle breeding, the semen of sires of the Holstein breed is used to increase the production of cows. Until today, no consensus is reached on the optimal proportion of blood of the improving breed.

Analysis of the milk production of black-motley cows on the farm showed that sires of Holstein lines have a positive effect on milk yield (milk production).

It should be noted that the most promising lines are Montvik Chieftain 95679 and Sealing Trayjun Rokit 252803 since cows clearly show an increase in the analyzed indicators when the proportion of Holstein blood increases. At the same time, sire bulls with improved genetics should be used to produce the offspring with increased milk yield, and milk fat and protein content. In this case, the fundamental factor for realization of the genetic potential is consistent with implementation of all technological solutions. It should be noted that genetic improvement of the herd is a long-term process. At the same time, further selection and breeding on the farms of the region should be aimed at breeding a new generation of cattle with a strong constitution and a stable genetic potential of high milk production.

Acknowledgments
The author would like to express his gratitude to Nikolai Vasilievich Andreev for his assistance in the study.

References
[1] Yin T and Konig S 2019 Genome-wide associations and detection of potential candidate genes for direct genetic and maternal genetic effects influencing dairy cattle body weight at different ages Genetics Selection Evolution 51 (4) DOI: 10.1186/s12711-018-0444-4
[2] Friedrich J, Brand B and Schwerin M 2015 Archives of Animal Breeding 58 13–21 DOI: 10.5194/aab-58-13
[3] Hanus O, Krizova L, Samkova E, Spicka J, Kucera J, Klimesova M, Roubal P and Jedelska R 2016 Effect of cattle breed, season and type of diet on the fatty acid profile of raw milk Archives of Animal Breeding 59 (3) 373–80 DOI: 10.5194/aab-59-373-2016
[4] Semkiv L P, Semkiv M V, Grishakina N I and Stanevich S V 2019 Innovation in dairy production as the basis of effective management The European Proceedings of Social & Behavioural Sciences EpSBS LXXVII-MTSDT 2019 54 446–53 DOI: https://doi.org/10.15405/epsbs.2019.12.05.54
[5] Le Cozler Y, Troccon J L, Marquis B and Faverdin P 2019 Early lactation performance in Holstein heifers first calving at 36 months and managed for high or low weight gain during mid- and late gestation Journal of Dairy Research 86 (3) 272–278 DOI: 10.1017/S002202991900044X

[6] Vrankovic L, Aladrovic J, Octenjak D, Bijelic D, Cvetnic L and Stojevic Z 2017 Milk fatty acid composition as an indicator of energy status in Holstein dairy cows Archives of Animal Breeding 60 (3) 205–212 DOI: 10.5194/aab-60-205-2017

[7] Moretti R, de Rezende MPG, Biffani S and Bozzi R 2018 Heritability and genetic correlations between rumination time and production traits in Holstein dairy cows during different lactation phases Journal of Animal Breeding and Genetics 135 (4) 293–99 DOI: 10.1111/jbg.12346

[8] Abdushaeva Ya M, Shtro O V and Vetkina A V 2019 Vegetable Resources Monitoring As The Region’s Raw Material Base Effective Management Tool LXXVII-MTSDT 2019 407–13

[9] Bevz S Y and Toshkina E A 2020 Cultivation of legume-grain agrocenoses for the purpose of resource saving in forage production IOP Conference Series: Earth and Environmental Science Vol. 422

[10] Kozina A M and Semkiv L P 2016 Human resources in the management of milk production Effective management in dairy cattle breeding as a condition for the competitiveness of milk production: proceedings of the All-Russian scientific-practical conference October 27–28, 2016 (Yaroslav-the-Wise Novgorod State University) 26–27

[11] Kozina A M, Semkiv L P and Grishakina N I 2019 Methodological approaches to improving human resources potential of agro-industrial complex The European Proceedings of Social & Behavioural Sciences EpSBS VOLUME LXXVII MTSDT 2019 47 391–97 DOI: https://doi.org/10.15405/epsbs.2019.12.05.47

[12] Abramova N I, Vlasova G S, Khromova O L et al. 2016 Improving the genealogical structure of the cattle population of black-motley breed in pedigree farms of Vologda region Zootechnics 6 2–4