Economically useful traits of cows depending from the various dates of their first insemination

S Yu Harlap¹, O Yu Zareva², N A Fedoseeva³, M V Voronov³ and T N Pimkina⁴

¹Ural State Agrarian University, Yekaterinburg, 620075, Russia
²South-Ural State Agrarian University, Troitsk, 457100, Russia
³Russian State Agrarian Correspondence University, Balashikha, 143900, Russia
⁴Kaluga branch of the Russian State Agrarian University - Moscow Agricultural Academy named after Timiryazev, Kaluga, 248007, Russia

E-mail: proffuniver@yandex.ru

Abstract. In Sverdlovsk region Holsteinized black-and-white cattle of the Ural type are being bred. This type of cattle is represented by numerous, highly productive animals with a high genetic potential for productivity. The aim of this article is to study the correlation of age of the first insemination of heifers on their economically useful traits. It was found that the age of the first insemination directly affects the milk productivity of Holsteinized black-and-white cattle of Ural type. The difference in age of the first insemination between the groups was 2.7 months, or 18.6%. The difference of productive period longevity between the groups was also observed, which was 0.21 of lactation (6.7%) in favor of the group that got its first insemination at age of 16-18 months. Cows inseminated for the first time at an earlier date featured lower parameters of milk productivity: lower milk yield for life, lower milk yield for the first lactation and for maximum lactation. The difference was significant at P≤0.01 in favor of cows which underwent the first insemination at age of 16-18 months for life-long milk yield. A significant difference in MFP in milk was revealed in favor of the cows in the first group (the period of the first insemination was 14-15 months). It was 0.09% at P≤0.01. The difference in MFP in milk did not have a considerable influence on increase of nutrients yield in milk, in particular milk protein. The duration of the period between calvings and the service period was long in both groups of cows, which allows concluding that, regardless of the age of first insemination, the decrease in reproductive capacity in cows of modern Holsteinized black-and-white cattle is observed. This is proved by the record KVS – 0.87 - 0.88.

1. Introduction
In the Main directions of Agricultural Development, the peculiar attention is paid to the development of breeding animal husbandry, as this industry is responsible for the sustainable supply of the population with nutritious, high-quality food like milk and dairy products. The dairy products can be consumed by people of any age, health status and income category, which ensures the health of the nation and food security of any country [1-7].

In this regard the peculiar attention is paid to the development of dairy cattle breeding, since the main share of milk (more than 97% of the total production) as a valuable food product and raw material for the dairy industry, is obtained from cattle. Strict requirements for milk quality are imposed on raw milk.
Therefore, along with increasing the productivity of cattle, the other tasks are set to the industry, in particular - the improvement of quality parameters of milk [8-12].

For milk production dairy cattle of both domestic and foreign selection are used. The main livestock is represented by the domestic black-and-white breed. In the recent few decades the genetics of the world best dairy breed, i.e. the Holstein, has been widely used to improve the animals’ quality. Long-term introduction of foreign breeding Holstein bulls led to creation of a numerous herd of Holsteinized cattle in various climatic and ecological forage zones of the country, which also differs among themselves in economically useful traits and biological characteristics, inherent to the breed resources of cattle within the breeding zone, used as an improved breed, the country of origin of the breeding bulls involved in crossbreeding and the food supply [13-19].

In Sverdlovsk region the broodstock of the black-and-white breed of the Ural offspring was inseminated with the servicing bulls of Canadian, Danish and German breeding. As a result, large-bodied, highly productive animals with a high genetic potential for productivity and well adapted to industrial milk production were obtained. In 2002 the Ural type of black-and-white cattle was officially registered with percentage of Holstein blood relationship of 75%. In subsequent years the purebred Holstein bulls continued to serve the herds, and the proportion of blood relationship in the broodstock increased to 91% and more for the Holstein breed [19-22].

Along with the increase in milk productivity, there was a decrease in productive longevity, which raised the acute issue of the herd reproduction and rising of young animals for replacement.

The research of correlation of the age of the heifers first insemination on their economically useful traits is relevant and of practical importance.

*The aim of the research* is to study the influence of the age of the heifers first insemination on their economically useful traits.

2. Materials and method

The research was run in one of the breeding farms engaged in breeding the Holsteinized black-and-white cattle of the Ural type. The research included cows that completed their lactation as of 01.10.2020. The animals were separated into 2 groups, depending on the age of their first insemination. Group 1 was inseminated at age of 14-15 months, and group 2 was inseminated at age of 16-18 months.

Data and records of zootechnical and breeding information from *Selex* database were used for analysis. Milk productivity was taken into account by control milking once a month, as well as by measuring of milk quality parameters: mass fraction of fat (MFF) and mass fraction of protein (MFP) in milk. These parameters per every cow were checked monthly in a dairy laboratory of OJSC “Uralplemcenter” of Sverdlovsk region. The coefficients of milk content, the amount of milk fat and milk protein were calculated. Reproductive functions of young cows were assessed according to the periods of their physiological cycle, the frequency of insemination and the coefficient of reproductivity.

3. Results and discussion

The economically useful traits of cows include parameters of milk productivity, which is assessed both in terms of quantitative and qualitative parameters. Figure 1 below shows the group ages at their first insemination.

The figure above clearly shows that the difference in age of the first insemination between the groups was 2.7 months, or 18.6%. The difference in the productive period longevity between the groups was also observed, which was 0.21 lactation (6.7%) in favor of the group with the first insemination at age of 16-18 months. Cows that were inseminated for the first time at an earlier age had lower milk productivity: lower milk yield for their life, lower milk yield for the first lactation and for maximum lactation. The difference was significant at P<0.01 in favor of cows with the first insemination at age of 16-18 months in terms of life-long milk yield (figure 2).
The positive trend was observed in terms of increase in milk yield in the first and maximum lactation among the cows that were inseminated at age of 16-18 months. Along with milk yield, great attention was paid to milk quality parameters, such as MFF and MFP in milk (figure 3).
A significant difference in MFP in milk was recorded in favor of cows of the first group (age of the first insemination was 14-15 months). It was 0.09% at P≤0.01. The difference in MFP in milk did not give a significant influence on increase of milk nutrients yield, in particular milk protein. However, the trend was observed to increase of milk fat from cows with a first insemination period of 16-18 months. Thus it can be concluded that the yield of nutrients per lactation depends on milk yield per lactation (figure 4).

In whole the yield of milk nutrients was 702 and 697 kg per groups respectively. The reproductive functions of the cattle broodstock are most often assessed by the longevity of their service period and the longevity of period between the calvings (figure 5).

The longevity of those periods was high in both groups of cows, which allows concluding that, regardless of the age of the first insemination, the decrease in reproductive functions in cows of modern Holsteinized black-and-white cattle was observed. The difference in longevity of these physiological periods, which were shorter in cows with a first insemination at age of 16-18 months, was insignificant. The longevity of the period between the calvings influenced on the coefficient of reproductive capacity, which ranged within 0.87-0.88, respectively per groups (figure 6).
Figure 6. The multiplicity of insemination and the coefficient of reproductive capability of cows.

The reproductive capacity coefficient below 0.95 indicates a decrease in reproductive functions in cows. There was a trend to increase in the coefficient of reproductive capacity and frequency of insemination in the group of cows that were inseminated for the first time at age of 16-18 months.

Our data is confirmed by researches of numerous authors, like by N Bogolyubova, V Korotky, A Zenkin, V Ryzhov, N Buryakov, V Mymrin, O Lorets, O Gorelik, O Lihodeevskaya, N Zezin, M Sevostyanov and O Leshonok.

4. Conclusion
Based on the foregoing, it can be concluded that the age of the first insemination affects the milk productivity of Holsteinized black-and-white cattle of the Ural type. The best yields were shown in cows with the first insemination at age of 16-18 months. There were no significant differences in reproductive qualities in cows with different ages of their first insemination.

References
[1] Smolnikova F et al. 2021 Developing milk-fruit drinks for school nutrition Journal of Natural Remedies 21 9(1) 72-7
[2] Gavrilova N et al. 2020 Specialized sports nutrition foods: Review International Journal of Pharmaceutical Research 12(2) 998-1003
[3] Morozova L et al. 2020 Improving the physiological and biochemical status of high-yielding cows through complete feeding International Journal of Pharmaceutical Research 12 2181-90
[4] Suychinov A et al. 2019 Vitamins and their role in human body International Journal of Pharmaceutical Research 11(3) 1246-8
[5] Smolnikova F et al. 2018 Nutritive Value Of Curd Product Enriched With Wheat Germ Research Journal of Pharmaceutical, Biological and Chemical Sciences (RJPBCS) 9(3) 1003-8 WOS:000438847100131
[6] Smolnikova F et al. 2019 Production technology and nutritional value of combined yogurt for dietary nutrition International Journal of Innovative Technology and Exploring Engineering 8(9) 1098-100
[7] Smolnikova F et al. 2019 Sour milk production technology and its nutritive value International Journal of Innovative Technology and Exploring Engineering 8(7) 670-2
[8] Gavrilova N et al. 2019 Biotechnology application in production of specialized dairy products using probiotic cultures immobilization International Journal of Innovative Technology and Exploring Engineering 8(6) 642-8
[9] Serikova A et al. 2018 Development Of Technology Of Fermented Milk Drink With Immune
Stimulating Properties  *Research Journal of Pharmaceutical, Biological and Chemical Sciences (RJPBCS)*  **9**(4) 495-500 WOS:000438848100062

[10] Sidra-Tul-Muntaha *et al.* 2020 Safety assessment of milk and indigenous milk products from different areas of Faisalabad *Journal of Microbiology, Biotechnology and Food Sciences* **9**(6) 1197-203

[11] Kuramshina N *et al.* 2019 Heavy metals content in meat and milk of Orenburg region of Russia *International Journal of Pharmaceutical Research* **11**(1) 1031-5

[12] Rebezov M *et al.* 2020 Monitoring the research results on the toxic elements content (lead, cadmium and arsenic) in food *IOP Conference Series: Earth and Environmental Science* **613**(1) 012123

[13] Rebezov M *et al.* 2021 Control of the stability of the results of studies of cadmium content using the method of additions in cow’s milk samples *IOP Conference Series: Earth and Environmental Science* **677**(5) 052051

[14] Gorelik V, Rebezov M, Lopaeva N, Smirnova E and Sultanova S 2021 Morphological and biochemical parameters of cow blood when using chitosan preparations *E3S Web of Conferences* **254** 08025 https://doi.org/10.1051/e3sconf/202125408025

[15] Gorelik O, Brjanzev A, Safronov S, Gritsenko S and Bobkova E 2021 Influence of the age of cows on the dynamics of dairy efficiency depending on a breeding line *IOP Conference Series: Earth and Environmental Science* **677**(4) 042015

[16] Gorelik O, Galushina P, Knysh I, Bobkova E and Grigoryants I 2021 Relationship between cow milk yield and milk quality indicators *IOP Conference Series: Earth and Environmental Science* **677**(3) 032013

[17] Gorelik O, Harlap S, Vinogradova N, Lykasova I and Belookova O 2021 Evaluation of the relationship between milk yield and the service period duration of cows *IOP Conference Series: Earth and Environmental Science* **677**(3) 032019

[18] Khaziakhmetov *et al.* 2021 Influence of the prebiotic feed additive vetokislanka the microflora of the feces and hematological parameters of calves of milk period *IOP Conference Series: Earth and Environmental Science* **677**(3) 032012

[19] Nigmatyanov *et al.* 2020 Nitrogen balance in energy-carbohydrate-fed cows *IOP Conference Series: Earth and Environmental Science* **613**(1) 012090

[20] Gorelik O *et al.* 2020 Assessment of the economically beneficial traits of mature cows of Holsteinized black-mottled breed *IOP Conference Series: Earth and Environmental Science* **613**(1) 012041

[21] Mikolaychik I *et al.* 2021 The relationship between the duration of the service period and the milk yield of the Holsteinized black-mottled breed *IOP Conference Series: Earth and Environmental Science* **677**(4) 042016

[22] Fedoseeva N *et al.* 2021 Evaluation of the efficiency of using black-mottled cows of the Ural type *IOP Conference Series: Earth and Environmental Science* **677**(2) 022105