Innovative approaches to breeding in the dairy industry

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Abstract. The article presents a study of the economic aspects of the dairy cattle artificial insemination use, including the sexed semen use. The authors’ classification of the breeding types is proposed, including on the insemination types basis and the used breeding material. The study aim is to determine the economic parameters of the dairy cattle artificial insemination system based on the use of foreign selection bulls sexed semen. Within the framework of this, the following tasks were solved: - foreign and domestic experience of using sexized semen was studied; - the breeding types classification has been developed; - production experience was carried out in the Samara region conditions; - the economic parameters of various scenarios for the dairy cattle use obtained using sexed semen have been determined. When considering the profitable part of the experiment, two scenarios were considered: - growing replacement young stock for pedigree sale to third-party organizations; - an increase in livestock for the commercial milk production. The profit from the implementation of the first scenario (the use of sperm divided by sex in the pedigree young stock sale) will amount to 7951.9 thousand rubles. The second scenario final profit, taking into account the first year production, will amount to 13026.8 thousand rubles. With further use in the production of this cattle, the additional income amount will increase by 4131.0 thousand rubles yearly. The maximum increase in the business economic efficiency (all other things being equal) is provided by the sexed semen technology use, which makes it possible to double the offspring of heifers and accordingly milk production. It makes possible to reach the farm breakeven point even without taking into account the payments of budgetary funds under the state support program.

1. Introduction
Selection work on the farm is one of the management priority areas, which is the key to high productivity in the industry [1-6]. Selection is carried out on the basis of genetics, the laws knowledge of which allows predicting the result of crossing individuals in order to obtain offspring with the most valuable traits [7-14]. Along with high productivity, farm animals must have physical endurance, resistance to various diseases, high reproductive abilities, have a well-developed udder that allows automatic milking [15-19].

Pedigree breeding of highly productive breeds requires the introduction of new technologies. These include advances in artificial insemination, special screening and assortment methods, and selection using modern computer technology. Bull sperm, divided by sex (sexed), is widely used in the world. The semen separation technique was developed in the USA. Efficiency (probability of the desired type individuals birth) - 90%. A certain sex ratio with this method is guaranteed by the manufacturer [20-31].
2. Materials and methods
The object of the research is economic relations in the process of carrying out artificial insemination measures in dairy cattle breeding based on the sexed semen use. The research methodology consists in the analysis of the artificial insemination method based on sexed semen and its economic aspects in relation to the Samara region conditions. In the study course, the abstract-logical method, situational and system analysis, economic and statistical methods, and the method of expert assessments were used.

In the work course, a breeding classification was proposed (figure 1).

![Breeding Types Classification](image)

Figure 1. The breeding types classification.

3. Results
In the Samara region, pedigree plants and reproducers play the main role in selection work in dairy cattle breeding. Currently, in the region in dairy cattle breeding, there is one pedigree plant and nine pedigree reproducers, which are engaged in the reproduction of the pedigree herd for the region and
neighboring regions agricultural enterprises. Data on the number cows and calves yield per 100 cows are given in table 1. An additional opportunity to improve the breeding enterprises efficiency is the introduction of cattle breeding innovative methods, including the widespread use of sexed semen.

Table 1. The cows number and the calves output in the Samara region breeding farms.

| Agricultural enterprise | Breed          | Cows 2014 | Cows 2015 | Cows 2017 | Cows 2018 | Calves output per 100 cows 2014 | Calves output per 100 cows 2015 | Calves output per 100 cows 2017 | Calves output per 100 cows 2018 |
|-------------------------|----------------|-----------|-----------|-----------|-----------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|
| Pedigree plant "Druzhba" | Black-motley   | 660       | 660       | 660       | 700       | 71                              | 73                              | 83                              | 87                              |
| Krasnogorskoie Radna    | Black-motley   | 380       | 380       | 380       | 9         | 85                              | 86                              | 76                              | 83                              |
| Pedigree plant "Kryazh" | Black-motley   | 520       | 520       | 520       | 520       | 80,5                            | 85,2                            | 87                              | 87                              |
| Collective farm named after Kuibyshev | Black-motley | 731       | 731       | 731       | 731       | 83                              | 85                              | 97                              | 88                              |
| Collective farm named after Kirov | Black-motley | 525       | 525       | 525       | 525       | 90                              | 90                              | 92                              | 95                              |
| Severny Klyuch          | Black-motley   | 1000      | 1000      | 1000      | 1000      | 86                              | 85,3                            | 87                              | 88                              |
| Niva                    | Black-motley   | 400       | 441       | 490       | 490       | 90,5                            | 90                              | 83                              | 75                              |
| Klondike                | Black-motley   | 150       | 151       | 151       | 152       | 83,3                            | 92,7                            | 94                              | 86                              |
| Usinskoe                | Black-motley   | 420       | 420       | 420       | 420       | 75                              | 83                              | 85                              | 81                              |
| Total                   |                | 6130      | 6396      | 6445      | 6115      | 83                              | 84                              | 86                              | 87                              |

Since 2004, the semen of sire bulls divided by sex (sexed) has been supplied to Russia [32]. The following are undeniable advantages of using sex sperm in dairy enterprises:

- Heifers introduction for repair and an increase in the breeding stock of the cattle herd;
- The sire-sires sexed semen use, the best in terms of genetic indicators, with a high index of breeding value (i.e. sire-sires sex semen special order for complexes) makes it possible to accelerate the herd genetic progress - to increase the cows’ milk production;
- The using sexed sperm effect is significantly increased when used on heifers due to genetic superiority over the main part of the herd, the heifers fertilization by sexed sperm with a single insemination is higher than that of cows [33-36].

It is also worth noting that, according to calculations, despite the cost of high-value breeding bulls producers sexed semen (about 2,000 - 3,500 rubles), the profitability of the company using this technology is higher than with the traditional approach.

For profitable milk production, it is necessary to constantly maintain a high level of reproduction dynamics of the dairy herd [37-42].

The sexed semen use - one of the innovative methods for animals’ intensive reproduction. Its essence is the sex-separated semen use with the predominant production of heifers in the offspring. This makes it possible to reduce the shortage of first-calf heifers for herd repair and to use more intensive of breeding bulls. However, this requires careful analysis of the breeding bulls’ quality whose semen is used [43-48].

North Caucasian Research Institute of Livestock (Krasnodar) conducted research on the effectiveness of the cows’ artificial insemination technology with bull sexed semen. The purpose of the research was to study the pedigree and economic value of Holstein black-motley bulls, from which
sex sperm was obtained, which was used at the Kuban breeding farm. Were taken sexed sperm from an experimental group of bulls-producers of the Holstein black-motley breed, which was inseminated by well-developed heifers of 15 months of age with a live weight of 400 kg. As a result of using 502 doses of sexed sperm at 55.4% fertility, 243 heifers (or 87.7%) were obtained, which is 37.7% more than in the control, that is, an additional 92 heads were obtained compared to the use of ordinary sperm. Received heifers and bulls of both groups were raised in the same way according to the dairy cattle breeding technology on compound starter feed. The first 2 months in individual cells, then in a group way loosely. Feeding was carried out according to zootechnical norms. The live weight of heifers obtained from separated and normal semen, respectively, was 36.66 ± 0.26 and 36.4 ± 0.07 kg at birth; at the age of 15 months 403.9 ± 3.56 and 401 ± 3.98 kg (P> 0.05). At 15 months of age, heifers of both groups in terms of growth and development are suitable for reproduction. It was found that, in fact, the growth and development of heifers obtained from separated sperm did not differ from the control heifers. The blood serum analysis for protein fractions, enzymes, vitamins, minerals in heifers of different ages, obtained from sperm, divided by sex, and normal did not reveal any differences. The additionally raised heifers are intended for the repair of the herd of cows. Net profit from additionally received 92 heifers amounted to 8832 thousand rubles.

Conclusions from the experiment:

- The Holstein breed bulls-producers, from which sperm was obtained, divided by sex, by the genetic potential of milk production, the exterior of the offspring are not inferior to the control bulls with ordinary sperm used at the breeding farm, slightly exceeding the latter in terms of calving ease;
- With artificial single insemination of heifers in production conditions, 55.4% of heifers' fertility was obtained, 87.7% of heifers among the offspring, which made it possible to obtain 92 heads of heifers more than ordinary sperm;
- The growth and development of heifers obtained from sexed and normal sperm at 15 months of age with intensive rearing technology allow to obtain heifers, respectively, with a live weight of 403.9 ± 3.56 kg and 401.03 ± 3.98 kg, suitable for reproduction;
- The economic effect from additionally received 92 heifers from sperm, divided by sex, (compared to the usual) amounted to 8.8 million rubles [49-58].

4. Discussion

In the Samara region conditions, a similar experiment was carried out in the conditions of LLC "Agrokom". Was calculated the economic efficiency of using sexed (divided by sex) bull sperm (at the rate of 200 heads).

The sexed semen cost, based on the cost of one dose (2739 rubles), double insemination and the used livestock (200 heads) amounted to 1095.6 thousand rubles. With an actual calf yield of 90%, 18 bulls and 162 heifers were obtained.

The cost of raising one heifer (from birth to first calving) amounted to approximately 19.17 thousand rubles. The cost of raising replacement bulls (up to 16 months of age) was 12.1 thousand rubles. The total cost of cultivation is 3123.54 thousand rubles. The total costs amounted to 5257.0 thousand rubles. When considering the profitable part of the experiment, two scenarios can be planned: - growing replacement young stock for pedigree sale to third-party organizations; - an increase in livestock for the production of commercial milk.

In the first scenario, income is generated from the sale of pedigree bulls at the age of 16-18 months and heifers at 4-5 months of pregnancy. Sale of breeding bulls (17 heads) at one head price of 48.0 thousand rubles will provide revenue in the amount of 816.0 thousand rubles. When selling heifers (153 heads) at a price of 81.0 thousand rubles income will be 12393.0 thousand rubles. Total from the sale of pedigree young animals: 13209.0 thousand rubles.
The profit from the first scenario implementation (the use of sperm divided by sex in the sale of pedigree young stock) will amount to 7951.9 thousand rubles.

The second scenario provides for an increase in own livestock for the production of commercial milk. In this case, the income part is formed by increasing the milk productivity of livestock of foreign breeding (the planned increase of 25%), reducing the period of rearing young animals (by 6 months), saving financial resources for purchasing replacement young animals.

It is assumed that due to the advanced genetics use, the increase in productivity is 20-50%. If the herd has a productivity of 6,000 kg, then 50% is 3,000 kg. In practice, taking into account the problems with feeding and maintenance, the increase in productivity will be reduced to 25% (1500 kg). With the sale of additional 1,500 kg of milk, the proceeds will be 4131.0 thousand rubles per year.

It should be taken into account that animals of imported selection have high growth energy compared to animals of domestic selection (under equal conditions of feeding and keeping). The sexual maturity of imported animals is reached at the age of 14-16 months with a weight of 320-350 kg (domestic breeding animals - 20-22 months with a weight of 320-350 kg). Additional costs for the maintenance of replacement heifers for 6 months will amount to 703.9 thousand rubles.

Saving money when raising your own replacement chicks is defined as the difference between the potential costs of purchasing breeding animals, costs of raising and insemination. The purchase price will be 12393.0 thousand rubles. The cost of raising replacement young stock, taking into account mortality, is 3105.5 thousand rubles. Costs for insemination with sexed semen - 1095.0 thousand rubles.

The final profit of the second scenario, taking into account the production of the first year, will amount to 13026.8 thousand rubles. With further use of this livestock in production, the amount of additional income will increase by 4131.0 thousand rubles yearly.

As world experience shows, one of the important characteristics of any highly developed country is the presence of an efficient livestock sector. It is the developed animal husbandry that provides adequate nutrition for the population and its viability.

The use of the artificial insemination technology with semen of high-value breeding bulls-producers will increase the number of dairy herds (relative to the traditional method - using a breeding bull). At the same time, the use of the sexed semen technology (bull semen separation by sex) of high-value breeding bulls-producers will significantly increase the birth of heifers.

5. Conclusion
In addition to the physical increase in the number of dairy herds, artificial insemination and embryo implantation technologies increase quality indicators (milk yield, milk quality, animal health) by improving the gene pool of livestock.

The production profitability level, the business economic efficiency maximum growth (all other things being equal) is provided by the use of the sexed semen technology of high-value breeding bulls-producers, which allow not only to double the offspring of heifers, but to increase milk yield, improve the milk quality, and improve the animals health and longevity. It makes possible to reach the breakeven point of the farm even without taking into account the payments of budgetary funds under the state support program.

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