Peculiarities of Growing Breeding Replacement Young Animals on the Farms of Ayrshire and Black Pied Cattle

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Abstract. The high genetic potential of productivity and a similar level of animal feeding underlie the intensive technology of rearing young animals for dairy cattle breeding. The realization of the genetic potential of dairy productivity of livestock largely depends on the efficiency of rearing young animals. Therefore, proper feeding of livestock is one of the main factors contributing to the maximum realization of this potential of animals. The conducted studies have shown that the breeding plants of the studied region successfully solve the issues of intensive cultivation of repair young animals. The increase in live weight of heifers allows for the first insemination at 16–17 months with the corresponding live weight. However, in the whole region, the data on the growth and development of heifers are significantly inferior to the indicators of breeding plants and the first insemination is carried out at 19 months and older. As a result of the conducted research, a plan for the growth of repair young animals was developed and the average daily live weight gains for the growing periods were recommended. The demand of reared young cattle for metabolic energy and crude protein is calculated.

1. Introduction

In the studies of many scientists, it is noted that when creating herds of highly productive animals, one of the most important measures is the breeding of replacement young animals [1, 2, 3, 4]. The main thing is to improve the breeding technologies used. They are the key to the intensification of the development of highly productive cattle breeding and determine the precocity, high productive qualities of animals and the duration of their life with good reproductive abilities [5, 6].

All the developed techniques of the technology of growing heifers for the replacement of the herd and, subsequently, heifers, are based on the laws of individual development, which begins in the embryonic period and is further consolidated by good feeding and decent conditions of maintenance created in the post-embryonic period.

As the experience of leading dairy enterprises shows, it is possible to ensure the realization of the genetic potential of bred dairy breeds of livestock, to increase the production efficiency and competitiveness of livestock products only on the basis of the introduction of scientific, technical and technological progress in dairy farming [7, 8, 9].

Breeding work is aimed at realizing the genetic potential and increasing the dairy productivity of the herd. Early assessment and selection of animals based on economically useful characteristics is a primary task in the practice of animal husbandry, which determines the relevance of this issue [10].
One of the main indicators of growth intensity is the live weight of repair heifers, their relative and average daily gains. A detailed analysis of these indicators gives a fairly clear idea of the intensity of growth and individual capabilities of the animal [11, 12, 13, 14].

In a number of farms of the Vologda region, heifers have a significant lag behind the existing standards for live weight in the control periods. The age of fruitful insemination often exceeds 20 months. The main reason for this is the lack of balanced feeding and non-compliance with zoohygienic requirements during development.

Therefore, the purpose of this research was to study the practice of intensive cultivation of replacement heifers of Black Pied and Ayrshire breeds in the conditions of the leading breeding enterprises of the Vologda region, and to develop a scientifically based program, the implementation of which helped to ensure the production of highly productive dairy cows with minimal costs for their cultivation in the farms of the region.

2. Materials and methods

In the course of the study, modern domestic and foreign developments, scientific and periodical literature on the subject of the study, official documents, and materials of breeding and zootechnical accounting were studied.

Based on the data of the primary zootechnical accounting of the breeding plant of Ayrshire cattle “Krasnaya Zvezda” and the main stud farms of the Vologda region, breeding cattle of the black-and-white breed: “Aurora”, “Mayskiy”, “Peredovoy”, “Prisukhonsky”, “Rodina”, a common database of the studied animals was formed. Taking into account the “Holsteinization” of some of the cattle in stud farms, the analyzed population of Black Pied dairy cattle was divided into groups, taking into account the share of Holstein blood.

In the context of groups by live weight at 6, 10, 12, 18 months and at the first insemination, the following indicators were studied: growth dynamics; the period of economic maturity (the age of the first insemination); productive indicators for the first lactation (milk yield for 305 days, the mass fraction of fat in milk, live weight).

In accordance with the objectives of the study, the existing systems for growing replacement young animals were analyzed and the most effective systems and parameters for growing young animals were identified on their basis. Data collection was carried out by visiting agricultural enterprises, studying primary documents, as well as using the electronic database “SELEKS”.

It should be noted that the technologies of growing replacement young animals have some differences in the studied breeding plants. In some cases, the traditional year-round stall system is used, in others, calves are raised in a dispensary on the “empty-occupied” principle.

And in the breeding plant “Mayskiy”, for example, heifers in the summer are kept under a canopy. Maternity departments have been established in the breeding plants “Peredovoy”, “Prigorodny”, “Rodina”, “Krasnaya Zvezda”. In stud farms that use the technology of tethered keeping, calving takes place in stalls.

Feeding calves with colostral milk is carried out within an hour after their birth using an average of 2–3.5 liters per calf. From an early age, calves are accustomed to concentrated and coarse feeds.

During puberty, increased attention is paid to the quality of diets, which contributes to the formation of highly productive livestock in the future.

To determine the readiness of heifers for insemination, they are weighed monthly, controlling the height at the withers, then formed into groups and when the required parameters are reached, they are inseminated.

3. Research results

Table 1 demonstrates the indicators of the level of development of replacement heifers raised in stud farms, and their subsequent productivity, as well as similar average regional data.

The figures shown in the table show that the most effectively raised breeding heifers of the Ayrshire breed, which at the end of the first lactation had an average milk yield of 6171 kg with a weight ratio of
fat 4.51%. When translating these indicators into the basic fat content, the company produced 8186 kg of milk from the first-calf heifer.

Table 1. Data on the growth of repair young animals in stud plants.

| Stud farm         | n   | Daily average growth, g | Indicator of the 1st lactation | feed consumption 1 heifer per year, feed units, c |
|-------------------|-----|--------------------------|-------------------------------|-----------------------------------------------|
|                   |     | from birth till 6 months | 6–12 months | 12 months s-1st insemination | 1st insemination, months | milk yield, kg | weight ratio of fat, % | milk yield of basic fat ratio, kg |
| “Krasnaya Zvezda” | 157 | 717                      | 644           | 642                         | 671                       | 16.0          | 6171                     | 4.51                           | 8186                           | 21.5 |
| “Aurora”          | 206 | 789                      | 717           | 533                         | 697                       | 16.7          | 7327                     | 3.64                           | 7844                           | 19.6 |
| “Mayskiy”         | 193 | 722                      | 744           | 592                         | 690                       | 17.4          | 6706                     | 4.03                           | 7949                           | 20.4 |
| “Peredovoy”       | 293 | 800                      | 678           | 558                         | 682                       | 17.5          | 5640                     | 3.94                           | 6536                           | 23.0 |
| “Prisukhonsky”    | 141 | 700                      | 672           | 605                         | 659                       | 18.0          | 6530                     | 3.86                           | 7413                           | 18.1 |
| “Rodina”          | 563 | 722                      | 728           | 691                         | 715                       | 17.4          | 6975                     | 3.85                           | 7898                           | 19.1 |
| Average for the region | 641 | 480                      | 588           | 19                          |                           | 5023          | 3.83                     | 5658                           | 21.5 |

In the herds of Black Pied cattle, the average milk yield of the first heifers when converted to the basic fat content was mainly higher than 7500 kg, and the average annual feed costs for growing heifers were 18–20.4 c of feed units with the exception of the “Peredovoy” breeding plant, where 23 c of feed units are spent on growing heifers per year, and the first heifer yield is the minimum of the presented ones.

The analysis showed that stable increments in the studied farms at the level of 700 to 800 grams by 6 months of age, from 644 to 744 grams from six to twelve months, and from 533 to 691 grams from one year to the age of the first insemination, provide an average age of the first insemination of 17.1 months. This technology of growing young animals of the best breeding farms is based on the rational use of feed and the peculiarities of the development of animals in different periods of ontogenesis, and subsequently makes it possible to obtain consistently high milk yields of first heifers with high fat content in all farms. This is confirmed by the value of milk yield in terms of basic fat content. In comparison with the average regional data on the growth indicators of repair young animals, advanced farms have the best indicators of average daily gains in the period from birth to the 1st insemination (from 671g in the “Krasnaya Zvezda”, to 715g in the “Rodina”), against 588g per day, on average in the region. Such average daily increments provide an earlier age of the first insemination by 1–2 months.

Thus, the technologies used in breeding farms can reduce the cost and feed consumption per head by raising repair heifers.

Targeted standards of live weight in the control periods of cultivation are presented in table 2.

For the Ayrshire breed bred in the study area limits on the live weight of heifers to the first insemination in 16 months age recommended within 330–350kg, and for pure-bred Black Pied breed
the first insemination is recommended in 17 months age and live weight of heifers in the range 380–410 kg.

In Holstinized herds, it is recommended to grow heifers to a total live weight of 370–390 kg by 16 months of age.

Table 2. Growth plan for the replacement of young animals.

| Indicators                                      | 6 months | 10 months | 12 months | 18 months | 1st insemination live weight, kg | 1st insemination age, months | live weight at 1st lactation |
|------------------------------------------------|----------|-----------|-----------|-----------|---------------------------------|-----------------------------|-----------------------------|
| **Ayrshire breed**                              |          |           |           |           |                                 |                             |                             |
| Limits on live weight, kg                       | 150–170  | 230–250   | 260–280   | 360–380   | 330–350                          |                             |                             |
| Average live weight at the end of the period, kg| 160      | 240       | 270       | 370       | 340                             | 16                          | 460                         |
| **Black Pied well-bred**                        |          |           |           |           |                                 |                             |                             |
| Limits on live weight, kg                       | 150–180  | 240–270   | 290–320   | 390–420   | 380–410                          |                             |                             |
| Average live weight at the end of the period, kg| 165      | 255       | 300       | 400       | 395                             | 17                          | 515                         |
| **Low-blood Holstinized**                       |          |           |           |           |                                 |                             |                             |
| Limits on live weight, kg                       | 160–180  | 240–260   | 290–310   | 410–430   | 370–390                          |                             |                             |
| Average live weight at the end of the period, kg| 170      | 250       | 300       | 420       | 380                             | 16                          | 520                         |
| **High-blood Holstinized**                      |          |           |           |           |                                 |                             |                             |
| Limits on live weight, kg                       | 180–200  | 260–280   | 300–320   | 410–430   | 370–390                          |                             |                             |
| Average live weight at the end of the period, kg| 190      | 270       | 310       | 420       | 380                             | 16                          | 530                         |

The age of the first insemination and the first calving, the feed costs per heifer, and the average productivity of the first heifers were the starting points for determining the growth plan of the animals. The introduction of these planned indicators into practice will allow obtaining the live weight required for insemination in farms at the optimal age of 16–17 months. This will also ensure high milk productivity in the future, while reducing the cost of growing.

Based on the offered standards of live weight, the average daily increments for the growing periods are indicated (table 3).

The revealed differences in the growth of heifers in the studied breeding herds are of a genetic nature (different blood types of animals), and also depend on the characteristics of the breeding technology in the farms. At the same time, a similar trend is observed in all the studied groups: the largest gains of heifers gain up to 12 months (at least half the body weight of an adult animal), and in older ages, the gains of heifers should not be reduced to less than 500 g, since this negatively affects the sexual cycles
of heifers. On average, for the entire growing period, the growth rate is recommended to be obtained in the range of 660–720 g.

Table 3. Average daily live weight gain by growing period.

| Period | Increment, g |
|--------|--------------|
|        | Black pied breed | Ayrshire breed |
|        | well-bred | low-blood Holsteinized | high-blood holsteinized |          |
| 0–6    | 750       | 780       | 880       | 760       |
| 6–12   | 750       | 720       | 770       | 760       |
| 12–18  | 560       | 670       | 600       | 560       |
| 0–1 y.o. | 720   | 730       | 730       | 660       |

To achieve the planned growth indicators, it is necessary to adhere to the following norms of metabolic energy and crude protein when feeding repair young animals (table 4).

The indicator of the level of crude protein is important, first of all, as an indicator of the effectiveness of the use of amino acids in the body of animals. The given energy nutritional value of feed, according to the need of animals for exchange energy, is determined at the existing level of feeding in breeding farms. The calculated ratio will ensure a normal physiological state, the required growth rate and the future optimal level of productivity.

Table 4. The demand of reared young animals for metabolic energy (ME) and crude protein (CP).

| Live weight, kg | Dry matter intake, kg/day | ME 500 g | CP 500 g | ME 600 g | CP 600 g | ME 700 g | CP 700 g | ME 800 g | CP 800 g |
|----------------|---------------------------|----------|----------|----------|----------|----------|----------|----------|----------|
| 150            | 3.0-4.0                   | 30.50    | 400      | 32.30    | 440      | 34.10    | 480      | 36.00    | 515      |
| 200            | 4.0-5.0                   | 37.40    | 450      | 39.60    | 490      | 42.00    | 525      | 44.30    | 560      |
| 250            | 5.0-6.0                   | 43.90    | 500      | 46.70    | 530      | 49.60    | 565      | 52.60    | 595      |
| 300            | 6.0-6.5                   | 50.40    | 570      | 53.60    | 610      | 57.60    | 660      | 60.80    | 690      |
| 350            | 6.5-7.0                   | 56.60    | 640      | 60.50    | 690      | 64.70    | 735      | 69.10    | 785      |
| 400            | 7.0-8.0                   | 62.80    | 710      | 67.30    | 765      | 72.20    | 825      | 77.50    | 880      |
| 450            | 7.5-9.0                   | 69.00    | 780      | 74.20    | 845      | 79.90    | 910      | 86.00    | 975      |
| 500            | 8.0-9.5                   | 75.10    | 850      | 81.00    | 925      | 87.50    | 1000     | 94.50    | 1070     |

It is recommended to train young animals (from 4 to 5 days of life) to concentrated feeds, which should have a coarse grind and a fiber content of up to 10%, in order to stimulate the development of the pre-ventricles, since an increase in the absorption area in the rumen has a beneficial effect on protein-lipid metabolism and stimulates the development of bacterial flora.

The entire range of feed products is preferably brought to the animals in the form of a feed mixture, which increases the digestibility of the diet and the digestibility of nutrients.

The conducted studies show that intensive rearing of heifers helps to reduce the age of first insemination, increasing the efficiency of work in the dairy cattle industry of the studied region.

4. Conclusion
1. The technology of growing breeding replacement young animals at leading stud farms is based on compliance with the content and application requirements of modern feeding methods that meet the needs of the body in protein, energy, carbohydrates, minerals and vitamins using full-fledged compound feeds, with the inclusion of concentrates and plant feeds from an early age.
2. To achieve the planned growth indicators, it is necessary to adhere to the norms of metabolic energy and crude protein recommended in the study when feeding repair young animals.

3. The entire range of feed products should be brought to the animals in the form of a feed mixture, which will increase the digestibility of feed, improve the digestibility and digestibility of nutrients in the diet.

The offered parameters of growth and development of young animals are the target criteria, the introduction of which will contribute to the successful formation of the future productivity of animals and the more complete realization of their genetic potential.

References

[1] Sivkin N V and Strekozov N I 2017 On the question of age and live weight at the first insemination of heifers of the Ayshire, Black Pied and Simmental breeds Molochnoe myasnoe skotovodstvo 2 3

[2] Galiev B H 2012 Reproductive ability of heifers under different feeding conditions Zootekhniya 5 27–28

[3] Cherepanov G G and Mikhal'sky A I 2016 The problem of searching for possible approaches for assessing the potential of viability and extending the terms of use of highly productive animals Problemy biologii produktivnykh zhivotnyh 1 5–25

[4] Pruitt J R, Gillespie J M, Nehring R F and Qushim B 2012 Adoption of technology, management practices, and production systems by U.S. beef cow-calf producers Journal of Agricultural and Applied Economics Vol. 44 2 203–222

[5] Pavlova S P and Emelyanov E G 2018 Features of growing repair young animals that ensure the growth of milk production in the farms of the Novgorod region Sovremennye resursosberegayushchie tekhnologii protivodstva moloka: ot teorii k praktike: materialy Vserossijskoj nauch.-prakt. konf. 7-8 noyabrya 2018g. 224–27

[6] Bollwein H, Janett F and Kaske M 2016 Impact of nutritional programming on the growth, health, and sexual development of bull calves DomestAnimEndocrinol. 180–90 DOI: 10.1016/j.domaniend.2016.02.006

[7] Novak I V 2017 Genotypic factors of influence on dairy productivity and reproductive ability of cows Aktual'nye problemy intensivnogo razvitiya zhivotovodstva: materialy XX Mezhdunarodnoj nauchno-prakticheskoj konferencii 1 107–109

[8] Davis Rincker L E, Vandehaar M J, Wol C A f, Liesman J S, Chapin L T and Weber Nielsen M S 2011 Effect of intensified feeding of heifer calves on growth, pubertal age, calving age, milk yield and economics J Dairy Sci. 94 (7) 3554–67 DOI: 10.3168/jds.2010-3923

[9] Roche S M, Renaud D L, Genore R, Shock D A, Bauman C, Croyle S, Kelton D F, Barkema H W, Dubuc J and Keefe G P 2020 Canadian national dairy study: describing canadian dairy producer practices and perceptions surrounding cull cow management Journal of dairy science 4 (103) 3414–3421

[10] Sergeev I I 2015 Expediency of early fertilization of heifers Zootekhniya 4 25–27

[11] Van De Stroet D L, Calderón Díaz J A, Stalder K J, Heinrichs A J and Dechow C D 2016 Association of calf growth traits with production characteristics in dairy cattle Journal of Dairy Science 99 8347–8355

[12] Krpáčková L, Cabrera V E, Kwapilík J, Burdych J and Crump P 2014 Associations between age at first calving, rearing average daily weight gain, herd milk yield and dairy herd production, reproduction, and profitability Journal of Dairy Science 97 6573–6582

[13] Khan M H, Manoj K and Pramod S 2016 Reproductive disorders in dairy cattle under semi-intensive system of rearing in North-Eastern India Veterinary World 9 (5) 512–18

[14] Nor N M, Steeneveld W, Van Werven T, Mourits N C M and Hogeveen H 2013 First calving age and first lactation milk production on Dutch dairy farms Journal of Dairy Science 96 (2) 981–992