

Artículo de investigación

Influence of paratypical factors on the productive longevity and lifelong productivity of Holstein cows of the Dutch selection of different generations

Влияние паратипических факторов на продуктивное долголетие и пожизненную продуктивность коров голштинской породы голландской селекции разных генераций

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Abstract

The duration of the economic use of cows is determined by a number of genotypic and paratypic factors. Without assessing the impact of these factors, it is difficult to succeed in improving this trait. The purpose of the research is to determine the influence of paratypical factors on the productive longevity and lifelong productivity of the Holstein black-and-white cows of the Dutch breeding of two generations. The study was carried out at Priozernoye OJSC of the Tyumen Region. The object of the study was cows of the Holstein black-and-white breed imported from Holland (zero generation) and

Аннотация

продолжительность хозяйственного использования коров обусловлена рядом генотипических и паратипических факторов без оценки влияния которых сложно добиться успеха в улучшении этого признака. Цель исследований: определить влияние паратипических факторов на продуктивное долголетие и пожизненную продуктивность коров голштинской черно-пестрой породы голландской селекции двух генераций. Исследования проводили в ОАО «Приозерное» Тюменской области. Объект исследования: коровы голштинской черно-

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their descendants of the first reproduction (first generation), who left the herd for seven years. The cows of the generations under study were divided into groups depending on the degree of paratypic factors: the age of the first calving, milk yield for 305 days of the first lactation and the average duration of the service period. The research results have shown that the zero-generation cows calving before the age of 24 months exceeded the peers calving at an older age (27-34 months) by 249-459 days ($p<0.05-0.01$) and 3,403-7,631 kg ($p<0.05-0.01$), respectively. A similar relationship between the characteristics was also observed among the cows of the first generation. A comprehensive analysis of the influence of paratypic factors on the studied traits has shown that the longest productive life and lifetime milk yield were characteristic of Holstein cows of the Dutch breeding of both generations, calving at the age of not later than 24-27 months, with a milk yield of 6,000-7,000 kg of milk in the first lactation and the duration of the service period of not more than 200-260 days.

Keywords: Cow, holstein black-and-white breed, productive longevity, lifelong productivity, paratypic factors, dutch selection, zero generation, first generation.

Introduction

Productive longevity of cows provides opportunities for increasing herd productivity and profitability of the dairy cattle industry. However, in recent years, the periods of use of dairy cows have been significantly reduced (Bascom, and Young, 1998; Chasovshchikova, 2014; Chasovshchikova, 2015; Koshchaev et al., 2018a; Nesterenko et al., 2017a; Nesterenko et al., 2017b; Plemashov et al., 2017). Longevity is a complex indicator and depends on a large number of factors. Extremely high dairy productivity often leads to a reduction in productive life in modern farms (Berry et al., 2005; Chernykh et al., 2017; Martens, and Bange, 2013; Smaragdov et al., 2016; Sobol et al., 2017; Starostina et al., 1997). In addition, productive longevity decreases due to metabolic disorders, decreased reproductive functions and

пестрой породы завезенные из Голландии (нулевая генерация) и их потомки первой репродукции (первая генерация), выбывшие из стада в течении семи лет. Коровы исследуемых генераций были разделены на группы в зависимости от выраженности паратипических факторов: возраст первого отела, удой за 305 дней первой лактации, средняя продолжительность сервис-периода. Результаты исследований показали, что коровы нулевой генерации, отелившиеся в возрасте до 24 месяцев – превосходили по продолжительности продуктивной жизни и пожизненному удою сверстниц, отелившихся в более старшем возрасте (27-34 месяцев) на 249-459 дней ($p<0,05-0,01$) и 3403-7631 кг ($p<0,05-0,01$) соответственно. Аналогичная зависимость между признаками прослеживалась и среди коров первой генерации. Комплексный анализ влияния паратипических факторов на исследуемые признаки показал, что наибольшая продолжительность продуктивной жизни и пожизненный удой, были характерны для коров голштинской породы голландской селекции обеих генераций, отелившихся в возрасте не позднее 24-27 месяцев, с удоём за первую лактацию 6000-7000 кг молока и продолжительностью сервис-периода не более 200-260 дней.

Ключевые слова: корова, голштинская черно-пестрая порода, продуктивное долголетие, пожизненный удой, паратипические факторы, голландская селекция, нулевая генерация, первая генерация.

mastitis (Koshchaev et al., 2016; Koshchaev et al., 2019; Nesterenko et al., 2018; Nesterenko et al., 2019a; Nesterenko et al., 2019b; Semyagin et al., 2017). Productive longevity of cows depends on the age of the first calving, live weight, exterior features and other paratypical factors (Kenijz et al., 2018; Kenijz et al., 2019; Kulikova et al., 2012; Leibova et al., 2016; Plutakhin et al., 2016; Sheveleva, 2006; Sheveleva, and Svyazhenina, 2006).

The aim of the study was to determine the influence of certain paratypical factors on the duration of economic use and lifelong productivity of Holstein cows of Dutch origin of zero and first genetic generations.

Materials and methods

The studies were conducted in a nucleus at the Priozernoye OJSC, Tyumen Region, Russia, on cows of the Holstein black-and-white breed of Dutch breeding of zero and first generations which were retired from the herd between 2008-2009 and 2014. Zero-generation animals were introduced into the nucleus by bred heifers in 2007. Cows of both generations were culled from the herd for the same reasons – mainly diseases of the limbs and reproductive organs. The proportion of animals of zero generation that were culled due to diseases of the limbs was 0.47, and it was 0.17 ($p < 0.05$) higher than in cows of the first generation. The proportions of animals of zero and first generations that were culled due to diseases of the reproductive organs did not differ significantly and were 0.12 and 0.17 of the total analyzed livestock, respectively.

The livestock of retired animals of two generations was divided into groups depending on the values of the paratypical factors associated with the duration of economic use and lifelong productivity. The paratypical factors were the following: the age of the first calving, milk yield during the 305 days of the first lactation, the lifelong average duration of the service period. During our study, we used the database of the “Selex” program, the results were processed using biometry and Microsoft Excel software.

Results and discussion

An analysis of the connection between the studied longevity indicators and the age of the first calving showed that among the zero-generation cows, individuals that calved before the age of 24 months had the longest productive life ($1,317 \pm 62.8$ days)

and the highest lifelong milk yield ($21,176 \pm 1,132.2$ kg). Moreover, these parameters were 249-459 days ($p < 0.05-0.01$) and 3,403-7,631 kg ($p < 0.05-0.01$) higher compared to the cows that calved at the age of 27-34 months. However, there were no significant differences between the animals of the first group and the cows that calved at the age of 25-27 months. The animals with the lowest calving age (before 24 months) also had the highest lifelong average milk yield per day – 9.5 ± 0.30 kg, which was 0.8-2.8 kg ($p < 0.05-0.001$) higher than in the cows that calved after the age of 24 months. However, milk yield per day during the productive life did not significantly differ between the groups.

Among cows of the first generation, cows that calved for the first time before the age of 27 months had the highest indicators of productive longevity. The duration of their productive life was $1,195.0 \pm 99.4$ days, and lifelong milk yield was $21,060.0 \pm 2,055.9$ kg. These parameters were 283-641 days ($p < 0.05-0.001$) and 8,121-11,798 kg ($p < 0.01-0.001$) higher than that in cows that calved at the age of 28-32 months. The lifelong average milk yield per day in the latter was 10.4 ± 0.56 kg, and it was 3.2-5.0 kg higher ($p < 0.01-0.001$).

Thus, in the studied generations, the cows that calved for the first time before the age of 27 months had the highest values of the productive longevity and lifelong productivity indicators. Calculation of confidence limits showed that the minimum age of the first calving for zero and first generations of animals was 23.3 and 24.2 months, respectively.

To determine the connection between the milk yield during the 305 days of the first lactation and the duration of productive life and lifelong productivity, retired cows were divided into groups depending on the milk yield (Table 1).

Table 1. The connection between the milk yield during the 305 days of the first lactation and the duration of productive life and lifelong productivity

Milk yield, thousand kg	n	Duration of productive life, days	Lifelong milk yield, kg	Milk yield per one day of life, kg	
				entire	productive
Less than 5	39 ⁰	$1,318 \pm 104.1$	$19,453 \pm 1,742.6$	8.4 ± 0.46^3	14.5 ± 0.39
	6 ¹	545 ± 89.4^4	$6,088 \pm 1,205.7^5$	4.2 ± 0.82^5	12.2 ± 2.48
5-6	93 ⁰	$1,192 \pm 57.1$	$18,166 \pm 994.8$	8.6 ± 0.27	15.3 ± 0.30
	5 ¹	921 ± 225.0	$15,413 \pm 4,490.3$	8.0 ± 1.70	16.1 ± 0.98
6-7	83 ⁰	$1,218 \pm 56.9$	$19,273 \pm 1,006.0$	9.1 ± 0.28	16.1 ± 0.34
	22 ¹	957 ± 86.2	$17,158 \pm 1,541.1$	8.8 ± 0.52	18.1 ± 0.36
More than 7	27 ⁰	$1,126 \pm 95.3$	$18,592 \pm 1,804.0$	8.9 ± 0.51	16.4 ± 0.68
	5 ¹	846 ± 187.5	$14,621 \pm 2,960.1$	7.9 ± 1.13	18.3 ± 1.99

Note: ⁰ – zero generation; ¹ – first generation; ³ – $p < 0.05$; ⁴ – $p < 0.01$; ⁵ – $p < 0.001$, compared to the maximum for a single generation.

Comparison of the duration of productive life of cows of zero generation with different values of milk yield during the 305 days of the first lactation showed that it had a tendency to decrease with increasing milk yield. Moreover, we observed a slight decrease in lifelong productivity. Individuals from the group with 6,001-7,000 kg milk yield had the highest average lifelong milk productivity per day and it was 0.7 kg ($p < 0.05$) higher compared to the group with the minimum milk yield (less than 5,000 kg). The largest amount of milk (16.4 ± 0.68 kg) per one productive day was obtained from cows with milk yield of 7,001 kg or more. Their milk yield per one productive day was 1.9 kg ($p < 0.05$) higher than in cows, milk yield of which during the first lactation was less than 5,000 kg.

Among the cows of the first generation, the individuals that yielded 6,001-7,000 kg of milk during the first lactation had the longest duration of economic use. Their productive life was 412 days ($p < 0.01$) longer and their lifelong milk productivity was 11,070 kg ($p < 0.001$) higher compared to the group with milk yield of less than 5,000 kg during the 305 days of the first lactation.

Cows that yielded 6,001-7,000 kg of milk also had significantly higher single-day productivity than the cows with milk yield of less than 5,000 kg and the difference was 4.6 kg ($p < 0.001$).

The study of the connection of productivity during the 305 days of the first lactation and the duration of productive life and lifelong productivity of cows showed that the milking capacity for the first-calf Holstein heifers should be increased to 6,000-7,000 kg during the 305 days of the first lactation. Milk yield of less than 5,000 kg should be considered ineffective, as at this level of productivity not only lifelong productivity is reduced but also the duration of productive life.

Study of the connection between the longevity indicators and the duration of the service period showed that zero-generation cows with a service period of 141-200 days (172 ± 2.2 days) had the longest productive life and the highest lifelong milk yield (Table 2). At the same time, both a reduction and an increase in the duration of the service period led to a decrease in the studied indicators. It should be noted that this was observed not only in the zero generation but also in the first generation of cows.

Table 2. The connection between the duration of the service period and the duration of productive life and lifelong productivity

Service period, days	n	Duration of productive life, days	Lifelong milk yield, kg	Milk yield per one day of life, kg	
				entire	
Less than 140	36 ⁰	1,075±92.6 ⁴	16,914±1,509.2 ⁵	8.5±0.40 ⁴	15.7±0.37 ³
	8 ¹	570±84.4 ⁵	8,736±1,582.4 ⁵	5.6±0.79 ⁵	15.8±1.75
141-200	49 ⁰	1,413±72.9	23,707±1,341.6	10.1±0.33	16.7±0.28
	8 ¹	912±165.1 ³	16,276±2,693.0 ³	8.7±0.86 ³	18.2±0.51
201-260	40 ⁰	1,294±86.5	20,965±1,480.5	9.6±0.37	16.2±0.34
	4 ¹	1,399±148.9	25,819±3,303.9	11.5±0.94	18.4±0.89
More than 260	92 ⁰	1,245±52.5	18,629±929.7 ⁴	8.6±0.26 ⁴	14.8±0.32 ⁵
	16 ¹	943±77.7 ³	15,570±1,649.4 ³	8.1±0.68 ⁴	16.3±1.05

Note: ⁰ – zero generation; ¹ – first generation; ³ – $p < 0.05$; ⁴ – $p < 0.01$; ⁵ – $p < 0.001$, compared to the maximum for a single generation.

The life expectancy of zero-generation cows that had a service period of 141-200 days was 338 days longer ($p < 0.01$) and lifelong milk yield was 5,078-6,793 kg ($p > 0.01-0.001$) higher than in cows that had service periods of 80-140 days and 261 days or more. The lifelong average milk yield per day was also 1.5-1.6 kg ($p > 0.01$)

higher in the first group (service period of 141-200 days) compared to other groups.

The first generation cows that had an average service period of 201-260 days (234 ± 8.9 days) had the best longevity indicators. The productive life of these animals was 456-829 days longer ($p < 0.05-0.001$) and lifelong milk yield was

10,249-17,083 kg ($p < 0.05-0.001$) higher than in cows that had service periods of less than 140 days (110 ± 6.4 days) and 260 days or more. The lifelong average milk yield per day was also 3.4-5.9 kg ($p < 0.01-0.001$) higher in the first group (service period of 201-260 days) compared to other groups (less than 140 days and 260 days or more).

Conclusion

Productive longevity and lifelong milk yield of Holstein cows of the studied generations depended on the age of the first calving, the milk yield during the first lactation and the duration of the service period. The longest productive life and the highest lifetime milk yield were observed in individuals that calved before the age of 24-27 months and had the milk yield of 6,000-7,000 kg during the first lactation and a service period of no more than 200-260 days.

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