Reproductive functions of cows and heifers of the Aberdeen-Angus Breed according to the calving season

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Abstract. This paper presents indicators of reproductive functions of cows and heifers of the Aberdeen-Angus breed depending on the calving season in one of the farms of the Central Federal district of Russia. 1.729 calves were received, including calving of cows with twins, or 0.6%. Calves are produced in spring, summer and autumn in 2019. In the summer, the highest number of complex calving (8.0%), abortions and stillbirths (5.8%) was observed. In summer, heifers have more difficulty calving than in spring. Animals calve more easily and with fewer abortions and stillbirths in the autumn months. Quantity of abortions and stillbirths in this period were 0.9%, it is significantly less than the average for the year. Young bulls birth weight did not affect the further increase in live weight until 5 months of age. The live weight of bulls in summer and autumn is higher than those born in spring; it was found (p≤0.001). We recommend to strengthen control over feeding and body condition of cows and heifers with calving summer time and to provide them shelter from the heat. Calving of cows in the spring, autumn, and heifer only in the spring are the most prosperous.

1. Introduction
In the regions of Russia, a national project for the development of beef cattle breeding is being implemented, which has allowed increasing the number of beef cattle [1]. Among imported meat breeds, the Aberdeen Angus breed is more popular. Aberdeen Angus breed is considered the best in the production of marbled beef [2]. In beef cattle breeding, the first and most significant is the "cow-calf" reproduction phase, which determines the zootechnical and economic indicators of the entire production as a whole. In this phase, the main task is to get one healthy calf from each cow every year. To achieve this goal, it is important that cows have good reproductive functions. In this regard, the study of reproduction indicators and factors affecting them is a very relevant issue [3].

2. Materials and methods
The data of one of the farms of the Central Federal district of Russia, which is engaged in breeding Aberdeen-Angus cattle, served as a material for study and analysis. When performing the work, we used practical experience in this farm, applied descriptive, statistical, computational and analytical methods with the use of a complex automated program for management and accounting based on "1C: management of an agricultural enterprise". The object of study was purebred animals of the Aberdeen-
Angus breed 3386 heads on the 20.01.2020. The gene pool of Aberdeen-Angus cattle in the company of the Central Federal district was created on the basis of the best gene pool of American breeding.

3. Results
The farm has 81 producing bulls (or 2.4%). They are divided into groups by age and occupy bases with shelters in places of feeding and rest. The total number of cows is 1813 or 53.5%. They are kept in the fields all year round, without any premises. The number of young animals after weaning is 769 heads or 22.7%, mostly repair heifers – 602 heads or 17.8%. In winter, they are located in the bases, and in summer on the pasture. The number of suckling calves - 380 heads or 11.2%. For each farm, it is important to get calves alive and keep them healthy, it is necessary to eliminate the causes of death of calves. Figure 2 shows the main causes of calves dying before weaning. The main cause of death of calves was caused by metabolic disorders (42%); death of calves due to digestive disorders – 36%; diseases of the respiratory system – 15%; death due to injuries – 7%. Indicators that characterize the reproductive functions of animals of the Aberdeen-Angus breed for 2019 are shown in table 1.

Table 1. Indicators of reproduction of Aberdeen-Angus cattle.

| Indicator                                                | 2019 year |
|----------------------------------------------------------|-----------|
| Age of 1 calving, month.                                 | 22–23     |
| Duration of the service period (time from calving to fertilization), days | 70–90     |
| Number of calves per 100 cows                            | 94.7      |
| Number of calves total                                   | 1729      |
| including multiple calving                              | 11        |
| including difficult calving                              | 55        |
| Number of abortions and stillbirths                      | 47        |
| Number of calves received total, heads                   | 1705      |
| including from cows                                     | 1437      |
| Including heifers                                       | 268       |
| Natural mating and artificial insemination, heads        | 1817      |
| Cows                                                     | 1524      |
| Heifers                                                  | 293       |
| % Conception rate                                        | >90       |

The first time animals are calved at the age of 22-23 months, which is an excellent indicator and indicates the correct cultivation of repair young and precocity of the breed. The duration of the service period ranges from 70 to 90 days, which corresponds to the acceptable norm. The yield of calves is 94.7%, which is slightly lower than the recommended figures of 97-98%.

The farm received 1,729 calves in 2019, including 11 multiple calves or 0.6%, which is lower than the average data for meat breeds. In General, the Aberdeen Angus breed is not characterized by multiple births. Total abortions and stillbirths for the year amounted to 47 heads or 2.7% of the total number of departments, difficult calving-55 heads or 3.2%, due to genetic factors and environmental conditions. Over the 2019 year, a total of 1,817 heads were artificially and naturally inseminated, including 1,524 cows and 293 heifers. The farm prepares in advance for the breeding season, makes changes to diets, and makes mating plans. When selecting bulls, pay attention to their appearance and body size, as well as the indicator of ease of calving female ancestors. Cows that have previously had difficult calving are not allowed for further breeding. Repair heifers are inseminated at the age of 13-14 months with a live weight of 350-360 kg with average fatness.

All heifers are subject to a single artificial insemination in a synchronized hunt, after which the group is introduced to the bulls for "cleaning", and the cows are included in the natural mating. Reproductive functions of cows and heifers are high, the percentage of fertilization is more than 90%, which is facilitated by good herd management, as well as fresh air, solar radiation and active exercise. Sick and young cows are culled on the basis of ultrasound data in a timely manner.
Table 2 shows the effect of the calving season on the reproductive functions of the Aberdeen-Angus breeding stock.

**Table 2.** Effect of the calving season on the reproductive functions of the Aberdeen-Angus breeding stock.

| Season | Number of calves | Including difficult calving | Number of abortions and stillbirths |
|--------|------------------|-----------------------------|-------------------------------------|
|        | in total | % | in total | % of calving total | in total | % of calving total |
| Winter | - | - | - | - | - | - |
| Spring | 1028 | 60.3 | 26 | 2.5 | 25 | 2.4 |
| Summer | 325 | 19.1 | 26 | 8.0 | 19 | 5.8 |
| Autumn | 352 | 20.6 | 3 | 0.9 | 3 | 0.9 |
| Subtotal | 1705 | 100 | 55 | 3.2 | 47 | 2.8 |

The largest number of calving up to 60% occurs in the spring months of the year, which is due to the best conditions for getting the maximum effect during this period. There are no departments in winter, as they are not economically justified. The number of complex calving totaled 55 or 3.2% of all calving on the farm, with the largest number occurring in the summer months of the year – 8.0%. The results obtained may be due to the technology of keeping and feeding animals during this period, as well as climatic conditions. The percentage of abortions and stillbirths is also higher in the summer months of the year and is equal to 5.8%, while the average for the year is 2.8%. According to our observations, animals that had difficult calving and stillborn offspring had a fatness of mostly 7 points or higher, that is, with excessive fatness. It should also be noted that abortions in heifers most often occurred after running them through a machine for regrouping and vaccination. Animals are easier to calve and with fewer abortions and stillbirths in the autumn months. Rates of difficult calving, as well as abortions and stillbirths in this period were 0.9%, which is significantly less than the average for the year. The reproductive functions of Aberdeen-Angus cows depending on the calving season are shown in table 3.

**Table 3.** Effect of the calving season on the reproductive functions of Aberdeen-Angus cows.

| Season | Number of calves | Including difficult calving | Number of abortions and stillbirths |
|--------|------------------|-----------------------------|-------------------------------------|
|        | in total | % | in total | % of calving total | in total | % of calving total |
| Winter | - | - | - | - | - | - |
| Spring | 801 | 55.7 | 16 | 2.0 | 15 | 1.9 |
| Summer | 284 | 19.8 | 15 | 5.2 | 10 | 3.5 |
| Autumn | 352 | 24.5 | 3 | 0.9 | 3 | 0.9 |
| Subtotal | 1437 | 100 | 34 | 2.4 | 28 | 1.4 |

For cows, spring accounts for 55.7% of all calving per year, and summer and autumn for 19.8 and 24.5%, respectively. Of these, more complex calving occurs in the summer months – 5.2%. Also during this period, there was the highest number of abortions and stillbirths – 3.5%.

Significantly less cows have complex calving, abortions and stillbirths observed in the fall – 0.9%. In the autumn months of the year, there are fewer different pathologies in the treatment of cows, which is associated with better conditions during this period.

Similar indicators were identified in heifers and are presented in table 4.
Table 4. Effect of the calving season on the reproductive functions of Aberdeen-Angus heifers

| Season | Number of calves in total | % | Including difficult calving in total | % of calving total | Number of abortions and stillbirths in total | % of calving total |
|--------|---------------------------|---|-------------------------------------|-------------------|---------------------------------------------|-------------------|
| Winter | -                         | - | -                                   | -                 | -                                           | -                 |
| Spring | 227                       | 84.7 | 10                                  | 4.4               | 10                                          | 4.4               |
| Summer | 41                        | 15.3 | 11                                  | 26.8              | 9                                           | 22.0              |
| Autumn | -                         | - | -                                   | -                 | -                                           | -                 |
| Subtotal | 268                      | 100 | 21                                  | 7.8               | 19                                          | 7.1               |

Calving of heifers occurs in the spring and summer months of the year, respectively, 84.7 and 15.3%. In comparison with cows, they have a much higher proportion of complex calving on average - 7.8%, especially in summer - 26.8%. There are also significantly more abortions and stillbirths in heifers on average - 7.1%, and in the summer months, this figure was 22.0%. All this may be due to a number of selection, technological, and climatic factors.

The average weight of newborn bull calves, depending on the season of the year, ranged from 22.94-22.99 – bull calves kg, 21.99-22.02 kg heifers and was higher in the autumn period of the year. Cow weight and birth weight in young bulls had a high correlation of 0.96 with a higher probability, that is, larger cows gave birth to larger calves. In heifers, there was a negative relationship between birth weight and further gains before weaning (r=0.096).

4. Discussion

Reproductive functions are of great economic importance and largely depend on the correct organization of herd management. It is estimated that the death of one calf is a loss of $ 400-500 or more [4].

The selection of the calving season depends on the feeding, environmental and market conditions of the breeding site. The techniques recommended for the breeding of livestock in the southern regions cannot be used for livestock adapted to the northern climate, and what is recommended for the reproduction of livestock in mountainous areas may be unacceptable for animals living in the plains.

The novelty of the studies carried out in the conditions of the economy of the Central Federal District of Russia is that for the first time in the conditions of this economy the influence of the calving season on the reproductive qualities and safety of Aberdeen-Angus calves adapted to the temperate continental climate of the central zone of the European part of Russia was considered.

According to our data, fewer abortions, stillbirths and difficult calving were observed in the autumn months. These data are consistent with other literature sources. A summer calving cows is not the best option for Virginia. High temperatures and poor feed quality during breeding lead to low reproduction rates. Studies have shown that high temperatures of environment of 104-106°F (40-41.1°C) are incompatible with successful reproduction [5-6]. Reproductive functions of cows decreased In the humid mid-Atlantic and southern states of the United States, the in the summer months.

In addition, the time of rapid growth of calves coincides with the period of limited grazing of cows [7]. In the state of Virginia (USA), autumn calving is popular. They take place in the period from September to November with an excellent state of the body. n autumn calving, reproduction rates are 5-10% higher than in spring calving. Most likely, this is a combination of better per-nutrition and lack of heat stress during the breeding season. Winter calving is not suitable for all farms in Virginia. Calves born in summer had weaning weights less than those born in autumn and winter [5]. American Angus Association, is breeding to improve the ease of calving.

Cows that had difficult calving took longer to recover. Subsequently, they had a low fertilization rate and at a later date brought offspring. The importance of selection for the ease of calving is confirmed by studies in the state of Montana (USA), it has been established that almost 50% of calves that die within the first day after birth, and most stillbirths are the result of calving problems. Calves
after a difficult birth move less and are more susceptible to adverse weather conditions. The first 72 hours of a calf's life have a great impact on its health and further productivity [8].

In the Aberdeen-Angus breed, the relationship between calving ease and birth weight is 0.65 [8-9]. Calving ease and birth weight are interrelated signs, \( r = + 0.65 \) [9-10].

In our research the average weight of newborn calves, depending on the season of the year, ranged from 22,94-22,99 –bull calves kg, 21,99-22,02 kg heifers and was higher in the autumn period of the year.

Fatness of cow also affected the ease of calving. Fatness was determined by the 9-point scale, it was found that cows with a fatness of 5-6 points (medium and slightly fleshy), have good activity and easy calving. Animals with an indicator of obesity (8-9 points) and skinny (1-3 points) were transferred to a different feeding diet.

5. Conclusion
As a result of the conducted research, it was found that the number of difficult calving, abortions and stillbirths increases in animals of the Aberdeen-Angus breed in the summer period. Moreover, these indicators are significantly higher in heifers than in cows. In summer, heifers have more difficulty calving than in spring. It is possible that this is due to the feeding of animals during this period, their physiological state, as well as climatic conditions and breed characteristics. The abundance of pasture grass in late spring, increased fat deposition in favourable conditions and intensive growth of the fetus in the last 2 months of pregnancy contribute to increasing the fatness of the Queens themselves and the weight of their fetus. Heat stress also has a negative effect on animals. And as a result, the number of complex calving, abortions and stillbirths increases in the summer period. Based on the research conducted, we recommend that the farm strengthen its control over the feeding and fatness of pregnant cows and especially heifers, whose calving is expected in the summer and provide for their shelter (tents) from the heat. Rearrangements and runs through the machine should be minimized and carried out in the morning, when it is cooler. Plan calving of cows in the spring and autumn months of the year, and not only in the spring. These measures will help to improve reproductive functions and production efficiency.

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