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Regulation of the Limousine cows' and Heifers' Reproductive Function

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Abstract. Methods for regulating the cows' reproductive function have been introduced into agricultural practice long ago. In most cases, the schemes existing in the Republic of Belarus are used in dairy farming. The present study is aimed at studying the effectiveness of using the "CO-Synch" scheme with subsequent resynchronization on Limousine beef cows and heifers using pharmacological agents, taking into account the animals age and the calving season. It has been found that the use of the sexual cyclicity synchronization-stimulation "CO-Synch" scheme contributed to the achievement of cows' breeding efficiency in 43.9–55.5% of cases. The initial injection of hormonal preparations to heifers has contributed to fertile conception in 9.0–12.5–47.6% of cases. Resynchronization has increased their breeding efficiency to 50.0–63.6%. The best breeding efficiency of 60.0–61.5% has been observed in cows aged 5–9 years. Pregnancy has been found in 75.0% of animals calved in winter, 71.9% in spring, and 66.7% in summer.

1. Introduction

Profitability in beef cattle breeding is determined by having a calf from a cow per year. The optimal calf yield is considered to be 75–80%. In this regard, the herd reproduction is an important element in the technology of producing beef from animals of meat breeds. At present, natural mating is used in most of the farms of the Republic of Belarus dealing with breeding beef animals. However, artificial insemination is one of the most effective tools for increasing the industry productivity and profitability. It allows the use of priced bulls for service, reducing their purchase and keeping costs. Rapidly increase the herd genetic potential by introducing replacement heifers from outstanding ancestors, organize seasonal calving at the most convenient time for each particular farm and at the same time reduce labour input for animal housing, veterinary handlings, and premises' depreciation.

In dairy cattle breeding, the biotechnology of breeding farm animals is well developed. However, the reproductive functions of beef cows have some peculiarities. Suction and prolonged presence of a calf has an inhibitory effect on the cows' sexual function through the neurohumoral system (increased release of prolactin by the hypophysis and suppression of the gonadotropic hormone secretion). This is



evident in the fact that cows often have a “quiet” heat, that is, without external signs [1]. Difficulties are created in identifying animals which are sexually eager, the physiological timing of insemination is held back, the cows’ calving interval is lengthened. Therefore, along with the improvement of the artificial insemination organization, it is important to reduce the means and methods of sexual cyclicity artificial regulation to practice, which allow to induce sexual heat in dams, inseminate them and plan calving at the optimal time. The most widely used schemes are “Ovsynch”, “Presynch” and their modifications. The methods are notable for high biotherapeutic and economic efficiency. By causing a rapid corpus luteum regression with subsequent follicles maturation and egg ovulation, they create prerequisites for programming such processes as insemination and animal birth. Opportunities for a clear organization of production processes and reproduction appear; with frontal insemination, the period of the breeding company is shortened [2]. Despite the fact that more active efforts to genetically identify and select beef cows with higher reproductive efficiency are made at international level [3, 4, 5], this is a longer-term strategy which will not replace the need for high technical efficiency and management practices at farm level [6].

Domestic and foreign experience shows that a high level of herd reproduction is achieved with the pastures maximum use and seasonal calving. Receiving calves in such seasons of the year when raising them provides farms with the highest productivity and low cost of liveweight gain, determines the industry economic indicators. The most common are winter-spring, spring-summer and summer-autumn calving [7, 8, 9]. The animals’ reproductive ability is directly dependent on the cows’ age, while calves with a greater liveweight have been received from 5–7 years old dams, and their fertility has been higher [10].

The aim of the work is to determine the effect of sexual cyclicity synchronization and stimulation on the reproductive function of Limousine dams depending on the calving season and age.

2. Research methodology

The studies were carried out from August 2020 to January 2021 in the farms of the Pripjat Polesie on Limousin cows and heifers. In total, 255 animals were subjected to obstetric-gynecological clinical examination, 234 of which were cows. Control over the reproductive system state, and then pregnancy diagnostics were carried out transrectally using the “BoviScan curve” ultrasound scanner.

Nonpregnant animals and animals with reproductive function disorders were formed into 2 groups: group 1–108 heads, group 2–51 heads.

To restore reproductive system disorders and stimulate sexual heat in cows and heifers, a complex mineral preparation (CMP), “Surfagon”, “Busol” and “Magestrofan” were used. CMP was injected once intramuscularly at a dose of 10 ml. “Surfagon”, “Busol” and “Magestrofan” were injected intramuscularly according to the “CO-Synch” scheme. Its main advantage, according to the authors [11], is that the synchronization procedure is shortened in time: the second GnRH treatment is combined with artificial insemination of cows which did not show signs of heat during the scheme application. 10 days before insemination, the first GnRH injection in a volume of 10 ml was carried out (when using “Busol” preparation – 3 ml), after 7 days – an PGF2 α injection in an amount of 3 ml, and 48–72 hours later – a second gonadotropin injection in an amount of 10 ml, with simultaneous artificial insemination [12].

Insemination of all experimental animals is artificial, once per heat, by recto-cervical method, with the sperm of a Limousine breeding bull for service LORD 300826.

Pregnancy research was carried out after 35–40 days. Nonpregnant animals were subjected to a second cycle of stimulation and synchronization, according to the scheme described above, forming one group of 92 animals (65 cows and 27 heifers). “Surfagon” was used as GnRH. After the second round of stimulation and synchronization, nonpregnant animals with obvious ovaries and uterus pathologies were culled.

In the third round of stimulation and synchronization, cows and heifers without identified pathologies which did not become pregnant two previous times and new heifers which reached the breeding age of 18 months and a liveweight of 380 kg were selected. A total of 54 heads (26 cows and 28 heifers) were inseminated.

The conditions for feeding and keeping cows were organized according to the accepted technology in beef cattle breeding, adapted to the farm conditions. During summer period, the animals were in a pasture. During winter period, the animals were housed in rooms without a tether on a deep, permanent bedding. Based on the studies carried out, the costs of the implementing the introduced measures were calculated.

Biometric processing of research materials was carried out by the variance analysis methods [13] using a PC. According to statistical indicators, the representative sample arithmetical mean (\bar{x}), the arithmetical mean error ($m\bar{x}$) and the validation criteria (t) of the difference between the studied indicators according to Student's t have been calculated.

3. Results and discussion

In animals with fertile conception, the time between the GnRH injections and prostaglandin F2 α varied within (-)2.1 – (+)2.7 hours from the recommended scheme (168 hours), and insemination – within (-)2.4 – (+)5.12 hours. In nonpregnant dams, the difference between the first injections increased slightly from (-)3 to (+)2.6 hours, and between prostaglandin F2 α and insemination – from (-)8.5 to (+)5.4 hours (statistically significant differences, P <0.001). Both the time increase between injections and insemination and the decrease negatively affected the fertile conception percentage in animals (Table 1). According to a number of researchers [14], the time between injections and subsequent insemination should be no more than ± 2 hours from the one recommended by the scheme.

Table 1. Intervals between injections and insemination, hours.

Parameters	Animals physiological state			
	Pregnant		Nonpregnant	
	GnRH – prostaglandin F2 α	prostaglandin F2 α – insemination	GnRH – prostaglandin F2 α	prostaglandin F2 α – insemination
min	165.9	69.6	165.0	63.5
max	170.7	77.1	170.6	77.4
Deviation from min	-2.1	-2.4	-3	-8.5
Deviation from max	+2.7	+5.1	+2.6	+5.4
$\bar{x} \pm m\bar{x}$	167.9 \pm 0.1	73.6 \pm 0.1	168.1 \pm 0.1	74.2 \pm 0.1***

*** P<0,001

The stage of the animal's sexual cyclicity at the moment of synchronization beginning has a significant effect on fertilization. The synchronization scheme begins with the GnRH injection, which promotes the ovulation of follicles contained in the ovaries or luteinization of an already ovulated follicle. During the prostaglandin injection, an active corpus luteum, which regresses and thereby allows a new follicle to develop, must be located in the ovaries. On the 10th day, all the reacted animals are at the proestrus stage. In the presented figure 1, a corpus luteum, which has undergone regression, is found on the right ovary and a formed (dominant) follicle next to it. On the left ovary – a well-developed corpus luteum and the first wave of growing follicles.

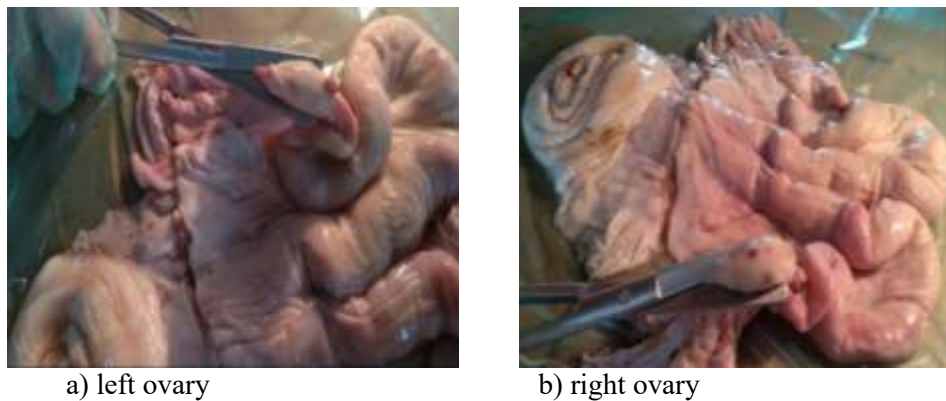


Figure 1. Cow’s ovaries 10 days after the “Surfagon” injection.

Gynecological ultrasound examination of 254 dams has shown that 22.4% of animals in the herd are pregnant, nonpregnant, including those with pathologies – 164 heads, 12.5% – with a gestation duration of less than a month. Among nonpregnant animals, 76.97% had no genital pathologies, 2.6% had endometritis, 1.3% had luteal cysts, and 0.7% had perineal rupture. The most common pathology among infertile cows was hypo-ovaria – 17.6%. This disease develops as a result of hormonal disorders in the cows’ body, often associated with insufficient or poor feeding. The data obtained are confirmed by similar studies obtained by Russian scientists P.I. Khristianovskiy and others [9] revealed from 12 to 54.6% of cows with hypo-ovaria from the number of nonpregnant cows. Balanced feeding contributed to the ovarian function recovery and the successful cows’ fertilization.

152 dams were selected for the sexual cyclicity synchronization-stimulation “CO-Synch” hormonal scheme. For quick and high-quality hormonal preparations injections and subsequent insemination, the selected animals were divided into 3 groups of 54, 48, and 50 animals, respectively (experiment 1). In the first and second groups, the “Busol” pharmacological preparation was used as GnRH, in the third group – “Surfagon”.

Cows’ fertility in the first two groups was 7.2% higher and amounted to 51.1%, heifers – 50%, which is 5.6% higher compared to the third group (figure 2).

86 animals underwent the re-synchronization (experiment 2): 60 cows and 26 heifers (including 16 heifers initially), the “Surfagon” pharmacological preparation was used as GnRH. Cows’ fertility was 51.6%, heifers – 34.6%.

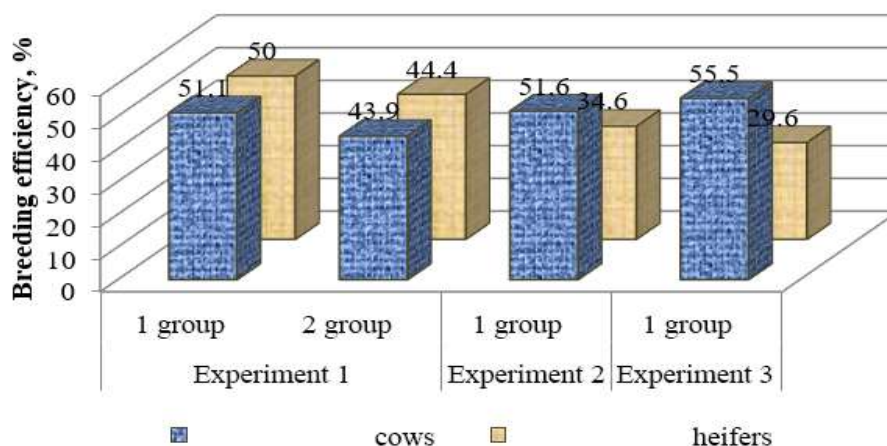


Figure 2. Breeding efficiency of cows and heifers.

The third experiment was formed from 26 cows and 17 heifers which remained nonpregnant and not culled from previous experiments, as well as 11 heifers which reached a liveweight of 380 kg were introduced into the experiment. Pregnancy was established in 55.5% of cows and 29.6% of heifers.

Throughout the study, breeding efficiency of heifers was low, 29.6%–50%. At the first hormonal preparations injection in all three experiments, 47.6–12.5 and 9.0% of the animals, respectively, became pregnant. Repeated hormones injections increased breeding efficiency up to 50.0–63.6%. Rectal ultrasound examination of nonpregnant heifers showed a large percentage of animals with disorders in the genitals – metratrophy – 52.9%, hypo-ovaria – 41.2%, animal freemartins were also found – 5.9%. Insufficient food supply, low-tech and haphazard use of pastures lead to the fact that the calves received grow poorly (they need to grow for more than two years up to a breeding weight of 380 kg), their development, the reproductive system one, first of all, is delayed.

In 2020, 49 calves were received from 159 experimental animals. Analysis of the calving distribution by seasons showed that the largest number of calving was obtained in spring period 65.3% (32 heads). Winter and summer periods accounted for 16.3% and 18.4% of calving, respectively. In 28.1% of cows calving between March and May, ovarian dysfunctions were observed in the form of one or both ovaries hypofunction. In animals calving in winter and summer, there were less such pathologies by 15.6% and 17%, respectively. However, the number of culled animals during these periods was 1.6% and 6.6% higher compared to animals calving in spring – 15.6%. The pregnancy rate was 75.0% of animals calving in winter and 71.9% in spring (table 2). Taking the animals' breeding efficiency into account, winter-spring calving can be considered the best.

Table 2. Indicators of herd reproduction depending on the calving season.

Indicators	Calving season					
	Winter		Spring		Summer	
	heads	%	heads	%	heads	%
Total calvings	8	16.3	32	65.3	9	18.4
Normal genitals	7	87.5	23	71.9	8	88.9
Hypo-ovaria	1	12.5	9	28.1	1	11.1
Breeding efficiency	6	75.0	23	71.9	6	66.7
Culled	2	25.0	5	15.6	2	22.2

The calving season in beef cattle breeding is influenced by the fodder availability. With poor feeding in winter, the summer-autumn period, when the animals are provided with adequate feeding on the pasture, is the best for calving. In this case, the number of embryonic mortality decreases to 8.3 and 6.2%, the total breeding efficiency of beef cattle increases to 91.7 and 93.8% [15].

The growing season on the Pripyat Polesie territory begins in April. This allows the cows to leave the wintering grounds for pasture and gain weight within 3–4 months on the growing grass before calving. The exercise, nutritional value of green grass contributes to a healthy fetal development, easy calving, formation of a sufficient milk amount for a newborn calf and preparation for a new breeding season.

The average cows' age was 8.3 years. The best breeding efficiency of 60.0–61.5% was observed in cows born in 2015–2017 (i.e. at the age of 5–9 years), the lowest – 29.4–31.25% in animals born in 2009–2014 (7–12 years old). With the age increasing, the cows' reproductive capacity decreases. In cost-effective beef cattle breeding, it is not profitable to keep a cow without a calf, a nonpregnant animal is culled (figure 3).

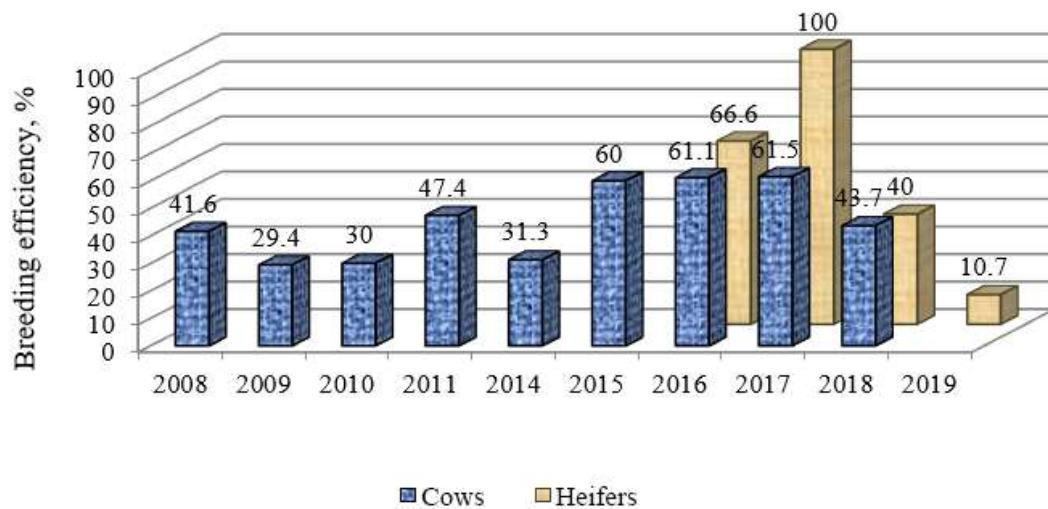


Figure 3. Breeding efficiency of cows and heifers depending on the birth year.

The average heifers' age for insemination is 33.8 months. 15 heifers born in 2018 and 25 heifers born in 2019 were inseminated, their breeding efficiency was 40.0% and 10.7%, respectively.

Heifers calved at the age of 2 years will produce more calves, they have higher productivity, fatness and a higher return of investment than heifers calved at the age of over 3 years [16]. In farms, the largest percentage of animals, 25.7%, and 30.7% are heifers at the age of 2–3 years, which have not brought offspring yet.

During the period of August 2020 – January 2021, a total of 305 cows and heifers were inseminated. For three stages of stimulation and synchronization, preparations were spent: “Surfagon” – 3940 ml, “Busol” – 648 ml, “Magestrofan” – 915 ml, CMP – 3050 ml. A total of 6709.2 Belorussian roubles were spent, 21.99 BYR – per animal.

4. Conclusion

Application of the sexual cyclicity synchronization-stimulation “CO-Synch” scheme has contributed to the cows' breeding efficiency in the range of 43.9% – 55.5% of cases. The use of the “Busol” pharmacological preparation has increased the breeding efficiency by 5.6–7.2%. The initial hormonal preparations injection to heifers has promoted fertile conception in 9.0% – 12.5% – 47.6% of cases. Resynchronization has increased their breeding efficiency to 50.0 – 63.6%. The age and calving season have not significantly affected the cows' reproductive qualities. The best breeding efficiency of 60.0 – 61.5% has been observed in cows aged 5 – 9 years. Pregnancy has been established – 75.0% of animals calving in winter, 71.9% of animals – in spring and 66.7% – in summer. The costs for the three stages of synchronization and stimulation have amounted to 21.99 BYR per animal.

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