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**A FIELD STUDY ON FERTILITY TRAITS OF HOLSTEIN
HEIFER AND COWS ARTIFICIALLY INSEMINATED
WITH SEXED BELGIAN BLUE SPERM AND GROWTH
CHARACTERISTICS OF CROSSBREED BELGIAN BLUE
× HOLSTEIN (F₁) MALE CALVES**

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Abstract

The study was conducted to investigate some reproductive traits of Holstein cattle inseminated with imported sexed male Belgian Blue semen and the growth characteristics of calves in Aydın province of Turkey. Totally 82 Holstein cattle including 29 heifers and 53 cows were inseminated. After the inseminations, some reproductive (the number of insemination per conception, conception rate, the dystocia rate, the rate of stillbirth) values were determined in the enterprises. The birth weights of the male calves were determined and in the following periods, the chest girth and body length values were determined for 6 months of age. In the study, it was observed that the average age of the first insemination was 14.05 months for heifers and 38.11 months for cows ($P < 0.05$). While more than half of the cows (52.08%) became pregnant in the first insemination, a great majority of the pregnancies (69.03%) of heifers occurred in the second inseminations ($P < 0.05$). The number of inseminations per conception were 2.13 and 1.79 for heifers and cows, respectively. While the conception rate was determined as 47.76% and 55.62% for heifers and cows respectively, dystocia rate were 43.10% and 25.75%, respectively. The average birth weight of the male calves were found as 42.75 kg and the 90th and 180th

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day live weights were 106.22 kg and 154.16 kg, respectively. While, the height at withers, body length and chest girth values were detected as 80.60 cm, 78.28 cm, 81.04 cm at birth, the same measurements were 94.45 cm, 94.22 cm and 109.79 cm; 108.46 cm, 110.88 cm and 129.45 cm for the 90th and 180th day, respectively. The corresponding study has clearly shown that the application in the project can create a dramatical meaning in dairy farms. This application can be used in dairy farms in a certain period to whole herd or a part of it.

Key words: Belgian Blue, crossbreeding, Holstein, sexed-semen

Introduction. Crossbreeding is among the basic treatments in livestock raising in improving the genetic structures of the animals in terms of gaining economic profits. Today, in the commercial crossing, which is the most common crossbreeding type, the main aim is to raise qualified cattle for slaughter that grow rapidly. One of the aims to perform crossbreeding in the dairies is that the enterprise wants to obtain calves that will be qualified fattening material for a specified period. It has been reported that the carcass to be obtained as a result of the cross-breeding of the dairy and beef breeds will be better than the dairy breeds in terms of quality and quantity [1]. Several studies in the past have focused on crossing beef and dairy cattle, and the differences between dairy and beef purebred cattle and beef crossbreds in both performance and economic traits are widening with time. When the situation in the world is examined, it has been reported that an understanding is in question in Germany in the way that it is advantageous to use crossbreeding for dairy enterprises; in the USA, it has been reported that the contribution of the crossbreeding, to be applied periodically in the dairy enterprises, to the enterprise is more, compared to the meat production. Also, some part of the Holstein cattle in England (5% of the population) and the beef bulls are exposed to artificial insemination in order to produce fattening material [2]. In the studies on crossbreeding of the dairy breeds with beef breeds, the Holstein breed are at the forefront, as can be seen in the England case. In the study in which the Holstein cows and different beef bulls have been inseminated in France, it was determined that the increases in the birth weights were 5 kg, 4 kg and 5 kg for the Charolais, Limousin, and Belgian Blue crossbreds, respectively. Also in the same study, increases of 10–40 kg in carcass weight were determined and an increase of 3–12% in the calving difficulty rates, which may be described as a negative situation, was observed. In addition, it has been reported that the negative effect of the calving difficulties may be minimized by using the multipara cows in crossbreeding [3].

Fertility traits can be influenced by some factors such as lactation number, breeding season, number of breedings and also semen type. Often in livestock production, one sex is more desirable to a producer. The desired sex can change between operations or an individual mating. The more desirable sex depends on the producer and the goals of the operation [4]. The insemination with sexed male semen provides economic benefits in terms of meat production in the dairy

enterprises and the sexed semen technology is considered to increase the effectivity of the progeny-test [5]. While it has been reported that the sexed semen of bulls may differ from each other in terms of fertility rates, it is considered that paying attention to determining the sire line is effective in decreasing the low fertility rates associated with the high dilution rate in the sexed semen [6].

In this study, it was aimed to reveal some reproductive values of the Holstein cattle inseminated with sexed male Belgian Blue semen and the growth characteristics of calves.

Materials and methods. *The study area, animals and data collections.* The study was conducted in the dairy enterprises in Aydin province. The experimental material comprised 82 Holstein cattle including 29 heifers and 53 cows; heifers obtained through the crossbreeding with the imported sexed (male) semen of the Belgian Blue cattle. This study used the data regarding the Holstein cattle from herds, all of which are the members of Cattle Breeders' Association of Aydin, Turkey. All the cows within a herd were scored on the same day. While the body condition of the cows between 3–4 are neither underweighted nor fat, briefly, the average milk yield was 28.3 kg. Cattle's identification numbers, lactation numbers and late calving date were recorded from farm's recognizing.

Currently, several types of Gonadotropin-releasing hormone/Prostaglandin $F_{2\alpha}$ and progesterone/progestin-based estrus synchronization protocols have been used in cattle breeding. In the present study, estrus was synchronized for heifer and cows in one of 4 ways: Prostaglandin $F_{2\alpha}$ injected in the first day (1), after two days, Gonadotropin-releasing hormone (GnRH) was applied to animals (2). The same procedure was repeated to animals for 9th and 11th days (3,4). Inseminations were performed the following 14–16 hours. Heifers and cows were inspected visually for standing estrus mornings and evenings and inseminated with sexed semen. Inseminations were done with either full straw, containing approximately 2×10^6 sperm which was purchased from a commercial company. Heifers returning to estrus were diagnosed as not pregnant, whereas heifers that did not return to estrus were diagnosed pregnant with ultrasonography or rectal palpation.

In the present study, the autumn season of calving was used in the analysis. The calves were individually penned in a calf shed during approximately 60 days of age. Then they were placed in a group pen and offered milk replacer from an automatic feeder, hay, and concentrate water were available ad libitum, during rearing period.

The study was designed as a prospective preliminary research and the inseminations were performed in the voluntary enterprises after the exchange of ideas and interviews made with the breeders.

After the inseminations, some reproductive (the number of insemination per conception, conception rate, the dystocia rate, the rate of stillbirth) values were determined in the enterprises. The birth weights of the male calves were deter-

mined and in the following periods, the chest girth and body length values were determined monthly for 6 months. The live weights and the zoomorphological body sizes of the calves up to 4 months of age were determined with the measurement and the interpolation was used for the last two-month data.

The study was approved by the Burdur Mehmet Akif Ersoy University Local Ethics Committee on Animal Experiments (05.04.2017, resolution number: 284).

Statistical analysis. The data were statistically compared by using Minitab statistical packaged software. An intense descriptive statistical analysis was applied on the data with the means and standart errors of means. Student's *t*-test was employed the defined differences between heifers and cows.

Results. Fertility traits. Table 1 shows some reproduction characteristics of cows and heifers following the use of the imported sexed (male) semen of Belgian Blue cattle in the study. It is evident from Table 1 that the average age of the first insemination was 14.05 months for heifers and 38.11 months for cows ($P < 0.05$). While more than half of the cows (52.08%) became pregnant in the first insemination, a great majority of the pregnancies (69.03%) of heifers occurred in the second inseminations ($P < 0.05$). In the study, while the number of inseminations per conception was 2.13 for the heifers, this number was 1.79 in the cows ($P < 0.05$). Also, the conception rate obtained by the imported sexed male semen of the Belgian Blue cattle was determined as 47.76% and 55.62%, respectively, for the heifers and the cows; whereas, the rate of dystocia was determined as 43.10% and 25.75%, respectively, ($P < 0.05$). While there were no stillbirths in the cows, this rate was determined as 8.33% in the heifers.

Growth characteristics of calves. Table 2 shows the live weight and some zoomorphological body size values reflecting the growing characteristics of

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Some fertility traits of Belgian Blue \times Holstein cattle using Sex-sorted sperm

Fertility traits	Heifers	Cows	<i>P</i>	Overall
Number of Inseminated Heifer/Cow	29	53		82
Mean age at first service (month)	14.05 ^b	38.11 ^a	**	29.57
Conception rate at first service (%)	20.28 ^b	52.08 ^a	**	40.82
Conception rate at second service (%)	69.03 ^a	42.90 ^b	**	51.73
Conception rate at third service (%)	10.69 ^a	5.02 ^b	*	7.45
Number of insemination per conception	2.13 ^a	1.79 ^b	*	2.18
Conception rate (%)	47.76 ^b	55.62 ^a	*	52.40
Dystocia rate (%)	43.10 ^a	25.75 ^b	**	31.86
Stillbirth rate (%)	8.33 ^a	0.00 ^b	**	8.33

^{a,b}Values in the same row with different superscripts are statistically different (*: $P < 0.05$, **: $P < 0.01$)



Fig. 1. Belgian Blue \times Holstein male calves

approximately half of the 43 male calves, born healthy in the insemination of heifers and cows with totally 82 sexed male semen of the Belgian Blue cattle. The average birth weight of the calves was 42.75 kg and the 60th and 120th day average live weights were 87.20 kg and 134.18, respectively. When the mentioned table was examined, it was observed that the height at withers and body length values were 80.60 cm, 90.51 cm, 99.16 cm, and 78.28 cm, 88.43 cm, 101.15 cm, respectively, for the same periods. In this study, the chest girth values of the male calves were found as 83.11 cm, 94.22 cm, 107.02 cm, and 110.88 cm for 30th, 90th, 150th, and 180th days, respectively.

Discussion. Reproduction which is one of the main factors determining the profitability and success of the dairy farms, also means more calf production and a higher level of selection opportunity by years. In order to determine the reproduction in a herd, the reproduction parameters should be determined [7]. The average age of the cattle, in the first insemination, one of these parameters, was found as 14.05 months in the present study (Table 1). It was reported that the age of the first insemination in the Holstein cattle were about 14–15 months with better management systems [8]. A major part of heifers (69.03%), inseminated within the scope of the study, became pregnant in the second insemination and the cows became pregnant mostly in the first insemination (52.8%). The low success rate of the first insemination especially in heifers may be thought to be

T a b l e 2

Growth characteristics of Belgian Blue \times Holstein male calves ($\bar{x} \pm S_{\bar{x}}$)

Traits	<i>N</i>	Liveability (%)	Live weight (kg)	Withers height (cm)	Chest girth (cm)	Body length (cm)
Birth	21	100.00	42.75 \pm 0.27	80.60 \pm 0.36	81.04 \pm 0.22	78.28 \pm 0.18
30th day	20	95.24	73.76 \pm 0.43	85.21 \pm 0.13	88.30 \pm 0.18	83.11 \pm 0.26
60th day	19	90.48	87.20 \pm 0.31	90.51 \pm 0.20	94.75 \pm 0.16	88.43 \pm 0.37
90th day	18	85.71	106.22 \pm 0.19	94.45 \pm 0.36	109.79 \pm 0.48	94.22 \pm 0.46
120th ay	18	85.71	134.18 \pm 0.45	99.16 \pm 0.78	117.29 \pm 0.11	101.15 \pm 0.10
150th day	18	85.71	148.20 \pm 0.57	104.10 \pm 0.32	123.14 \pm 0.39	107.02 \pm 0.17
180th day	18	85.71	154.16 \pm 0.89	108.46 \pm 0.29	129.45 \pm 0.16	110.88 \pm 0.49

relatively associated with early insemination age compared to the conditions of Turkey. However, it may be asserted that the number of the insemination per conception, is relatively over the acceptable limits [9] for an ideal dairy enterprise. It is considered that performing the study in the breeder conditions and in more than 10 enterprises are effective in the forming of the mentioned situation.

When 82 cattle inseminated with the Belgian Blue male semen were assessed within the scope of the study, the conception rate was determined as 47.76% for the heifers and 55.62% for the cows. While there are studies indicating that the conception rates, gained with the sexed semen, has been found to be significantly low compared to conventional method [10], it has been also reported that the difference in conception rates between two methods started to decrease [11]. In addition, it has been also reported that the conception rates in the field conditions may vary between 35% and 40% [12]. The fertility success in the artificial insemination, performed with low dose sexed semen in dairy farms, where a good herd management is performed, may be close to the fertility rates that may be obtained from the inseminations performed with normal dose semen. Many factors affect the success of the insemination performed with the sexed semen. CERCHIARO et al. [6] reported in their study that the sexed semen of the bulls may be different from each other in terms of the fertility rates and therefore, paying attention to determination of the sire line may be effective in increasing the low fertility rates. Also, it was reported that higher levels of conception rates may be reached in cows and heifers with the sexed semen by determining the females in estrus and performing controlled inseminations [13]. The fact that the conception rates in the study were relatively higher compared to those reported in the literature, was thought to be due to the quality of the imported sexed male semen as well as the insemination of the animals carefully in the period following their estrus.

The body size of the calf at birth is important in terms of the calf losses in calving difficulty and the following period. A large calf is the reason for calving difficulty and very weak calves may cause losses in the liveability. It was observed

that the dystocia rates determined in the study for the heifers (43.10%) and the cows (25.75%) were quite higher than the rates of 5% and 11%, reported by the researcher for the Holstein cattle [14]. Based on the fact that besides the intrauterine development, the care-feeding methods of the dam during the conception are also important in the formation of the calving difficulty, it may be considered that high dystocia rate reported especially for heifers is caused by the non-uniform management reasons that are included in the dairy conditions. Also as stated before, the early first insemination age in heifers and the large body sizes of the male calves may be regarded among the reasons for increasing the calving difficulty rates. Additionally, MALTECCA et al. [15] determined the low calving and calving difficulty rates as 29.7% and 17.1%, respectively, in the scoring they have performed about calving difficulty for the male calf births in Holstein and Holstein × Jersey crossbreeds. Similar to this study, in a study conducted on Brown Swiss cross breeds, that had more beef cattle characteristics, compared to the Holstein cattle, it was observed that the calving difficulty rate for the primiparous animals was 45% and this rate decreased to 23% as the number of calving increased [16].

Like dystocia, stillbirth rate is also among the reproduction criteria to consider as it causes an economic loss for dairy farms. In this study, after the insemination with the sexed male semen of the Belgian Blue cattle, the stillbirth rate in heifers was 8.33% and there was no calving difficulty in cows. NORMAN et al. [12] stated that when the sexed semen was used in the multipara cows in the USA, significantly less stillbirths were observed compared to heifers and the stillbirth was 10.4% for the heifers and 2.7% for the cows. As a reason for this situation, it was considered that lack of providing adequate management procedures for heifers during their conception had a role.

The calves grow healthy, therefore the high liveability rate is a desired situation for the dairy enterprises. In the study, the liveability rates of the Belgian Blue × Holstein crossbreed male calves decreased in the first three months (95.24%, 90.48%, and 85.71%), however, there was no loss in the calves that were followed in the period between 3–6 months. It was observed that the liveability rates stated in the study were in conformity with the survival of the calves produced by traditional insemination. Parallel to this situation, it has been reported that there is no difference between the growth performances of the calves produced from the cows inseminated with the semen frozen with the normal technique and the calves produced from the cows inseminated with the sexed semen [10,13].

The birth weight of the calves is one of the most important criteria in reflecting the growth and development of calves after birth. In the study, the average birth weight of the male calves crossbred from the Belgian Blue × Holstein was determined as 42.75 kg. While PRAHARANI et al. [17] reported similar birth weight (42.20 kg) for Belgian Blue × Holstein crossbreeds; BLÖTTNER et al. [16] stated that the birth weight of the calves born from Holstein × (Brown Swiss

× Holstein) crossbreeding was 43 kg. Also, there are studies reporting the birth weights of the male Holstein calves around 41 kg [18], however, there are also studies reporting lower birth weights [3,6,15,17,19]. In this study, the live weight values of the calves in the second, fourth, and sixth months were determined as 87.20 kg, 134.18 kg, and 154.16 kg, respectively. The live weight values of the calves at the age of 60 days were higher compared to the values reported by ARRAYET et al. [18]; however, they were lower than the values reported by WILSON et al. [20]. Although the live weights in the 6th month in this study fall behind those reported by the literature, it was considered that this situation was caused by the management procedure in many different dairy enterprises.

In this study, besides the live weights of the calves, some of their zoomorphological body sizes (height at withers, chest girth and body length), providing to have knowledge about growth, production and reproduction performance of the calves and one of the crucial means for describing the cattle breeds, were determined. Wilson et al. [20] stated that the chest girth, height at withers, and body length values for the Holstein calves aged 2 months and 4 months were 106.2 cm, 90.5 cm, 87.3 cm, and 132.9 cm, 104.9 cm, 106.6 cm, respectively. Among these values, only the chest girth was higher than the values of the present study and also in another study conducted on Holstein calves that have relatively similar values with the values of the present study, the height at withers and chest girth values of the calves aged 3 and 6 months were reported as 91 cm, 109 cm, and 107 cm, 132 cm, respectively [19].

Conclusions. This study has brought a new approach to the beef production from dairy farms. This approach can be considered as a help to solve the red meat problems in Turkey and the countries using similar livestock systems. Male sexed sperms may also be practiced to produce fattening material from dairy cattle. The corresponding study has clearly shown that the application in the project can create a dramatical meaning in dairy farms. This application can be used in dairy farms in a certain period to a whole herd or a part of it. Obtained and raised male calves are the indicator of this system and its procedure.

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