Scientific Works. Series C. Veterinary Medicine. Vol. LXI (1)
ISSN 2065-1295; ISSN 2343-9394 (CD-ROM); ISSN 2067-3663 (Online); ISSN-L 2065-1295

THE EFFECT OF SIRE SELECTION ON PRODUCTIVITY IN HOLSTEIN HEIFERS

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Abstract

This study aimed to determine the effects of sire selection on survival rate of calf, milk yield and reproductive parameters in high-yield dairy heifers. In the study, milk yield and reproduction parameters of 293 Holstein heifers from 7 bulls were determined. It was obtained that the first insemination age was higher in the daughter of number 1 bull. This statistical difference outcame from the daughter of number 1 bull (P<0.05). When calved age was determined, the daughter of the number 1 bull were higher than those of 2, 5 and 7 bulls (P<0.05). There was no effect of sire on the conception length of heifers, however there was significant effect of sire on live weights of hiefer during insemination period (P<0.05). The effect of bull on birth weight of calves was significant (P<0.05). Birth weights of calves were highest in the daughters of number 2 and 7 bulls, were lowest in the daughters of number 1 and 5 bulls. The effect of sire on lactation milk yield, lactation length and lactaion peak duration of the daughter were not significant, however was significant on peak yield (P<0.05). The birth type was significant on survival rate of calves. Survival rate of single born was 3.5 time higher than twins. In conclusion, the selection of bulls was found effective on reproductive parameters and birth weights of calves, however was ineffective on the lactation milk yield, lactation length and lactation peak duration except peak milk yield.

Key words: *sire selection, heifer, milk yield, reproduction, calf.*

INTRODUCTION

High milk production and efficiency of reproductive yield are economically important traits in dairy cows. Profitableness of a dairy cow business can only be achieved by obtaining maximum milk production to the extent permitted by genotypic structure and high reproductive yield (Ozcelik et al., 2000). Reproductive yield is a comprehensive term which includes many parameters such as offspring yield. Reproductive yield is a parameter including some features such as gestation period, calving interval, age at first calving, number of inseminations per gestation, service period and number of straggler cows(Bayril et al., 2010a; Berry et al., 2014). Milk yield is a parameter which includes lactation milk yield, lactation period, peak yield and peak period(Bayril et al, 2010b).

Income of a dairy cow business is mostly generated by milk and calves(Wathes et al, 2014). In addition, a significant income is earned by selling breeding heifers. It is fundamental to obtain a calf from a cow every year for lifelong high milk production and calving. Thus, the ability of fertility must be high(Bach, 2011). Therefore, it is important to impregnate a heifer and obtain calves at the possible earliest age which does not negatively affect the growth, development, constitution and future yields(Wathes et al., 2014).

Since the age of first insemination and calving is the time at which the business begins to obtain economic benefit, it is very important in cattle breeding. This feature also plays role in productivity. Growth capacity of dairy heifers has been increasing in parallel with the selections to increase milk production yield. Decrease in the age of first calving has provided

advantage in herd management and decrease in herd renewal costs(Pirlo et al., 2000: Van Amburgh et al., 1998).
This study was conducted to determine the effect of sire selection on milk and fertility parameters of Holstein dairy cows.

MATERIALS AND METHODS

Management, feeding of the cows and data recording

In the study, 293 Holstein heifers of seven bulls of a private business were used as material (as frozen sperma). The heifers were housed in free movement paddocks as groups containing 25-30 heifers and fed by ration composed of corn silage, alfalfa hay, wheat straw and concentrate feed. Feeding was performed twice daily with 12 hours interval. Water was provided by automatic drinking bowls ad libitum. Heifers aged 14 months were inseminated by frozen sperma of the bulls (Anadolu Hayvancılık, Istanbul, Turkey) selected by herd management programme of the business. The heifers were taken to individual birth places 5 days before calving. 5 days after calving, heifers were taken to paddocks having automatic drinking bowls, free range, rubber beds, automatic enriching, cooling system with water spraying and fan. They were fed by mixed ration composed of corn silage, dry alfalfa hay, wheat straw and concentrate feed during lactation period. Feeding was performed by automatic feed mixing machine three times a day with 8 hours intervals (Unifit, Tekniktürk, Izmir, Turkey). Milking was done by automatic milking rotary system (Rotary Magnum 90, Westfalia Surge, Izmir Turkey) three times a day with 8 hours intervals. Individual milk yield parameters and live weights of the cows (Taxatron, Westfalia Surge, Izmir, Turkey) were measured by electronic systems in every milking and automatically recorded via computerized herd programme (DairyPlan C21 herd management programme, Westfalia surge, Izmir, Turkey). Estrus was detected by increased activity of the cows determined by a pedometer (Activity meters, Westfalia Surge, Izmir, Turkey), information given by zookeepers, increased tonus of uterine horns in rectal examination and presence of graafian follicle in ovarium. Fertility records of the heifers and the cows in the first lactation period were obtained from computerized herd management programme.

Statistical analysis

Descriptive statistics of continuous variables were expressed as mean, standard error, minimum and maximum values, while categorical variables were expressed as numbers and percentages. In terms of continuous variables, single direction variance analysis was performed to compare the mean values of the groups. In addition, logistic regression analysis was performed to determine the effects of other variables on the viability of the calves. 5% was accepted as statistically significant level in the calculations and SPSS statistics package programme was used for calculations.

RESULTS AND DISCUSSION

The data on the first insemination age, calving age, period of gestation and live weights of breeding bulls were presented in Table 1. The table shows that daughters of number 1 breeding bull had the highest age for the first insemination and statistical difference was due to daughters of this bull ($P<0.05$). In the evaluation of calving age, it was seen that the daughters of number 1 bull had higher calving ages when compared to the daughters of number 2, 5 and 7 bulls ($P<0.05$). It was also seen that sire had no effect on the gestation period of the heifers used in breeding, while the effect of sire was important in live weights during insemination period ($P<0.05$).
In farming business, it is important to impregnate the animals at the possible earliest age in order to make heifers the participants of the production process, while taking care not to negatively affect the growth, productivity and constitutions (Daşkaya 2005; Hamşa 2002). In the study,

the mean value for the first insemination age was found to be highest for the daughters of number 1 bull (516,06±11,16 days) and this created the difference. In the studies conducted by Sehar et al.(2005) and Erdem et al.(1997) the mean values for the first insemination age were 572,43±9,13 and 538,4±50 days, respectively. These values were higher than the values detected in our study. Given that the optimal first insemination age is 15-16 months in modern business (Akman, 1999; Şekerden et al. 1997), the proximity of our results to optimum value (15-17 months) may indicate that herd management had been properly applied in the private business in which the study was conducted.

The studies of Holstein herds have shown that the highest performance and economic return would be obtained from the heifers which give birth at the age of 23-24 months (Pirlo et al., 2000). In the study, the mean value for first calving age related to first insemination age was found to be highest in the daughters of number 1 bull (804,43± 11,3 days). It is seen that this value was higher than the optimal first calving age, but the mean values of first calving ages of other bulls were more close to the optimal value. In Holstein studies, the first calving ages were 936.7±33.2 days in the study of Kopuzlu et al. (2008) and 830,6±5.0 days in the study of Sehar et al. (2005). Atashi et al. (2006) reported that the first calving age was 801,5 ±93,2 days, which was consistent with the study.

Growth capacity of the dairy heifers has continuously increased with the selections made so in order to increase the milk production. Decrease in the first calving age, however, has provided advantage in the herd management and reduced the herd replacement costs. To provide the low age of the first calving in heifers, a suitable live weight and body size are required in the calving period. This can be achieved by the heifers having sufficient growth rate genetically and a good heifer management program (Wathes et al., 2014). That the daily live weight between the birth and the first conception age increases from 0.68 to 0.82 kg shortens the first pregnancy age by 32 days ((Bar-Peled et al., 1997). Some researchers have reported that the high live weight in the calving period has a positive effect on the first lactation milk production (Davis Rincker et al., 2011; Soberon et al., 2012). In the study conducted, it was detected that female bulls no. 4 and 5 had a higher live weight, but this did not have any effect of the milk production.

Table 1. Age at first insemination (day), calving age (day), gestation period (day) and body weight (kg) of Heifer.

Item	Bulls	Heifer(n)	$\bar{X}$	$S_{\bar{X}}$	Min.	Max.	P
AFI	1	35	516,1 a	11,2	458	733	*
	2	39	476,7 b	4,6	445	552	
	3	57	485,2 b	3,8	445	575	
	4	40	481,2 b	5,9	438	590	
	5	41	474,6 b	2,8	450	544	
	6	43	491,6 b	3,8	450	571	
	7	38	477,7 b	4,8	445	559	
AFC	1	35	804,4a	11,3	729	1020	*
	2	39	774,5 b	7,5	723	912	
	3	57	781,7 ab	5,7	718	914	
	4	40	790,1 ab	14,3	719	1215	
	5	41	772,6b	7,6	707	960	
	6	43	793,1 ab	7,7	727	984	
	7	38	769,1 b	6,9	723	912	
GP	1	35	276,7	,89	266	287	-
	2	39	277,6	,72	270	290	
	3	57	276,6	,59	261	283	
	4	40	275,4	,83	261	286	
	5	41	276,3	,81	261	289	
	6	43	275,4	,78	261	286	
	7	38	277,2	,71	270	290	
BW	1	35	499,7 ab	5,1	431	554	*
	2	39	481,3 b	7,1	398	588	
	3	56	495,7 ab	6,1	376	622	
	4	40	511,13 a	6,9	379	595	
	5	41	505,7 a	7,8	399	647	
	6	43	495,7 ab	7,6	385	650	
	7	38	480,1 b	7,0	398	588	

ITY: Age at First Insemination, AFC: Age at First Calving, GP: Gestation Period, BW: Body Weight.

Table 2 shows lactation milk yield, lactation period, peak milk yield and peak period (days) of the daughters of breeding bulls. Table 2 reveals that the effect of sire on lactation milk yield, lactation period and peak lactation period of the cows was insignificant, but the effect of sire on lactation peak yield of the cows was found to be significant (P<0.05).

High milk production is one of the economically important features in the dairy cattle. Profit from a dairy cow business can be achieved only by obtaining maximum milk production allowed by genotypic structure(Lohakare et al., 2012). Therefore, the main object in the dairy cattle raising enterprises is to increase the milk production per cow by accommodating highly productive cows. In the study conducted, lactation milk production was similar among all the groups. Milk production levels in the studies made by some researchers and our levels show similarity(Cady, 1991;Castillo-Juarez, 2000;Costa et al., 2000). However, it was observed that the findings of some other researchers were lower than the levels reported in the study(Haile-Mariam, 2003;Bayram, 2006).

The period starting from the secretion of milk until the cessation of milk is called lactation. Lactation period varies between the races, the herds and the cows(Alpan, 1998). In our study, no difference was observed in the levels of the lactation among the groups. When compared to the other studies,(Ojongo et al., 2002; Haile-Mariam, 2003;Bayril et al., 2010b) the lactation period was longer. It can be said that this difference was based on the high milk productions of the heifers.

Subsequent to calving, the milk production continues by increasing and is maximized within 3-8 weeks (Etgen et al., 1987). High lactation milk production is associated with high peak milk production. The higher the peak milk production and the longer the peak milk production period, the higher the lactation milk production will be(Schmidt et al., 1998). In the study conducted, the peak milk production was higher in daughters of sires no. 1 and 4 and the difference was based thereon. In the current study, it was observed that the average peak milk productions of all the daugther of sires were higher than the other studies (Bayril et al., 2010b; Oneil et al., 2013). Thus, it is seen that the dairy cow business has approached to the expected target in relation to the milk production feature.

Table 2. Lactation milk yield (kg), lactation period (day), peak milk yield (kg) and peak duration(day) of Heifer.

	Bulls	n	$\overline{X}$	$S_{\overline{x}}$	Min.	Max.	P
LMY	1	34	10010,8	346,35	7040	15009	-
	2	32	10713,5	318,84	7371	15329	
	3	38	10794,2	390,78	7653	18176	
	4	36	10620,4	255,46	7329	14247	
	5	36	10710,3	334,11	7260	16869	
	6	35	10540,5	223,45	8674	15024	
	7	30	10481,9	452,93	7200	16188	
LD	1	34	334,2	9,47	268	485	-
	2	32	351,8	11,60	276	552	
	3	38	356,9	11,91	281	553	
	4	36	341,4	5,91	278	392	
	5	36	365,8	11,88	272	575	
	6	35	336,8	6,89	289	456	
	7	30	366,2	15,59	273	593	
pMY	1	34	38,7a	1,1373	29,42	53,34	*
	2	32	37,3 ab	1,0164	27,16	50,10	
	3	38	36,2 b	,5798	27,15	43,97	
	4	36	38,9 a	,6632	29,07	44,91	
	5	36	35,3 b	,5936	26,91	43,02	
	6	35	35,9 b	,6484	30,64	41,36	
	7	27	35,2 b	,8110	29,09	46,46	
PD	1	34	69,1	4,19	29	141	-
	2	32	69,2	4,32	36	134	
	3	38	69,6	3,33	29	120	
	4	36	56,4	2,79	29	79	
	5	36	69,5	4,02	22	134	
	6	35	64,7	3,95	36	122	
	7	30	72,9	4,55	36	134	

LMY: Lactation Milk Yield, LD: Lactation Duration, pMY:Peak Milk Yield, PY: Peak Yield, PD: Peak Duration

Birth weights of the daughters of breeding bulls were presented in Table 3. These data shows that the effect of the bulls on birth weights of the calves was significant (P<0.05). The daughters of number 2 and 7 bulls had the highest birth weights, while the daughters of number 1 and 5 bulls had the lowest birth weights. One of the most important factors affecting the profitability in the dairy cow enterprises is the calf obtained from a cow annually. The main target in the dairy cattle raising is to obtain

a calf annually (Yüceer, 2008). To overcome the loss of calf, the calves are required to exhibit growth and development according to their races. The first parameter of the growth is the birth weight. To be more precise, the birth weight is the easiest and the most reliable parameter of the growth. Moreover, the birth weight is an important factor affecting the postnatal growth and development (Akbulut et al., 2001). The birth weight is affected by the genetic and environmental factors. In the study, when the calf birth weights were compared, significant differences were observed. This difference was based on the higher calf birth weights of the sires no. 2 (42.86kg) and 7 (42.86kg). Some researchers have found lower calf birth weights than ours in their studies (Kertz et al., 1997; Sparks et al., 2003; Bayril et al., 2010c). However, Arrayet et al.(2002) have reported higher calf birth weight.

Table 3. The birth weights of calves (kg).

Item	Bulls	Calf (n)	$\bar{x}$	$S_{\bar{x}}$	Min.	Max.	P
CW	1	75	41,2 b	,503	30	52	*
	2	101	42,8 a	,469	32	55	
	3	135	42,2 ab	,449	32	55	
	4	93	41,5 ab	,483	31	58	
	5	87	40,9 b	,483	32	54	
	6	100	42,3 ab	,500	28	53	
	7	101	42,9 a	,469	32	55	

CW: Calf Weight

Effects of some factors on the viability of the calves were presented in Table 4. It shows that the effect of the type of delivery was important in viability and viability of twins was 3,5 fold lower when compared to single births.

Twin birth is an undesirable situation in the dairy cow enterprises. The cow pregnant with twins decreases the vitality, increases the mortality rates and reduces the reproductive performance. High birth weight increases the vitality(Bendixen et al., 1989;Nielen et al., 1989). That the twin calves have a lower birth weight than the single-born calves causes decrease in the vitality. In the study, it was observed that the vitality of the twin calves was 3.5 times lower than the single-born calves.

Calf breeding is an important source for the breeders due to the replacement of the herd and the income obtained from the sale of thereof. Increase in the calf deaths further increases the business expenses such as insemination, treatment of the sick animals, and the feed costs. Calf deaths are one of the most important indicators of the health condition in the dairy cow enterprises. Numerous factors such as management, calving season, colostrum quality, diseases and sex of the calf, play a role in the calf deaths(Holland et al., 1992). Some researchers have reported that sex of the calf has no effect on the vitality (Ertugrul et al., 2000; Bayril et al., 2010c). Our findings are in conformity with these results.

Table 4. The effect of some factors on the survival rate of calf

						95% CI for odds	
	B	SE	Wald	Sig.	Odss	Lower	Upper
Sex of calf (1)	,068	,275	,062	,804	1,071	,625	1,835
Birth weight	,049	,031	2,566	,109	1,050	,989	1,115
Birth type (1)	1,278	,426	8,980	,003	3,588	1,556	8,275
Bull No			3,523	,741			
1	,019	,563	,001	,973	1,020	,338	3,074
2	,000	,502	,000	1,000	1,000	,374	2,674
3	,209	,488	,184	,668	1,233	,473	3,209
4	-,484	,478	1,025	,311	,616	,241	1,573
5	-,435	,488	,792	,373	,648	,249	1,686
6	-,190	,484	,154	,695	,827	,320	2,137
Constant	-,895	1,336	,449	,503	,409		

The effect of birty type on survival rate of calves is significan (P<0.01)

CONCLUSION

In conclusion, the selection of sires was found effective on reproductive parameters and birth weights of calves, however was ineffective on the lactation milk yield, lactation length and lactation peak duration except peak milk yield.

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