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EFFECT OF SOME ENVIRONMENTAL FACTORS ON ABORTION AND OFFSPRING SEX RATIO IN HOLSTEIN COWS IN IRAQ

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ABSTRACT
A statistical analysis was conducted for 17787 records of offspring's belonged to Holstein cows at Nasr Dairy Cattle Station from 1999 to 2004 to investigate the effect of some fixed factors on abortion and offspring sex ratio. Data were analaysed using General Linear Model within the SAS program to investigate the effect of some fixed factors (season and year of calving, parity, age at first calving and sex of calf) on abortion and the effect of season and year of conception, parity, age at first calving and calving interval on offspring sex ratio. The overall mean for abortion was 5.80% and only the effect of season and year of calving was significant ($P < 0.01$), whereas, the overall mean of sex ratio was 51.05% and only the effect of year of conception and calving interval were significant ($P < 0.05$).

KEY WORDS: Dairy cattle, abortion, sex ratio, environmental effects etc.

INTRODUCTION

Abortion in dairy cattle is commonly defined as a loss of the fetus between the age of 42 days and approximately 260 days (Hovingh, 2002). Pregnancies lost before 42 days are usually referred to as early embryonic deaths, whereas, a calf that is born dead between 260 days and full term is defined as stillbirth (Jousan *et al*., 2005). A low rate of abortions is usually observed on farm and 3 to 5 abortions per 100 pregnancies per year are often considered normal (Hovingh, 2002). However, the loss of any pregnancy can represent a significant loss of (potential) income to the producer (Forar *et al*, 1996). The diagnosis of abortions often presents a challenge to the herd owner and the herd veterinarian. Although a gradual increase in the abortion rate in a herd may be noted over a period of many years, a sudden and dramatic increase is more commonly seen (Howard and Smith, 1999). While infectious agents are perhaps the most frequently thought of cause of bovine abortion, there are other factors which may cause a proportion of pregnancies to terminate with an abortion, such as genetic abnormalities in the fetus (King, 1990), heat stress which can affect reproductive performance in a dairy herd, toxic agents (mycotoxins and aflatoxin), fungi, bacteria and viruses (Engels *et al*., 1981; Stringfellow *et al*., 1982; James *et al*., 1992).

The greatest early embryonic mortality and increased number of abortions occurring in cows may affect the offspring sex ratio despite the probability theory dictates that the ratio should be 50:50 in situations of evolutionary equilibrium. There was substantial evidence exists that sex ratio can be strikingly skewed from this balance (Rosenfeld and Roberts, 2004). Skjervold and James, (1979) summarized a body of work showing a sex ratio in dairy cattle in excess of 60% in cows carrying male. The objective of this study was to investigate the effect of some environmental effects on abortion and the offspring sex ratio in dairy cattle in one of the most important herds in Iraq.

MATERIALS AND METHODS

Data included 17787 records on total parturition of Holstein cows in Nasr Dairy Cattle Station United Company for Animal Resources between the years 1990 and 2004. The data were analyzed to investigate the effect of the season and year of calving, parity, age at first calving and sex of calf on abortion and the effect of season and year of conception, parity, age at first calving and calving interval on offspring sex ratio. Cows having more than 5 calves were grouped into the same class. All of results presented here were based on single abortion of calf. No data for abortion associated with twins were included. In this study, we defined calves which were considered aborted as abortion if the gestation period not accessed the 260 days.

Statistical analysis

Statistical analysis included 17787 records for abortion and offspring sex ratios were carried out using SAS (2001). Duncan's multiple range tests were performed on all main effect means affecting the two traits. Sum of squares were estimated using type III test of GLM procedure of SAS. The principle effects included in the fitted first model were:

$$Yijklmn = \mu + Ei + Rj + Pk + Sl + Am + eijklmn$$

Where Yijkmn = first trait considered in this study (abortion), μ = overall means, Ei = the fixed effect of i^{th} calving season (i= 1 – 4), Rj = the fixed effect of j^{th} calving year (j=1990-2004), Pk = the fixed effect of k^{th} parity (k=1 – 6), Sl =the fixed effect of l^{th} sex(l=1 – 2), Am = the fixed effect of m^{th} age at first calving(1 = lower than 30

years, 2 = 30 – 33, 3 = higher than 33), eijklmn = the residual effect. The principle effects included in the fitted second model were:

Yijklmn = μ + Ei + Rj + Pk +Cl + Am+ eijklmn

Where Yijkmn = the second trait considered in this study (sex ratio), μ = overall means, Ei = the fixed effect of i th conception season (i= 1 – 4), Rj = the fixed effect of j th conception year (j=1989-2003), Pk = the fixed effect of k th parity (k=1 – 6), Cl =the fixed effect of l th calving interval (l= lower than 366 days, 2= 366 – 450 , 451 – 535 , more than 535), Am = the fixed effect of m th age at first calving (1 = lower than 30 months, 2 = 30 – 33, 3 = higher than 33 months), eijklmn = the residual effect.

RESULTS AND DISCUSSION

Least square means of abortion for the major phenotypic effects affecting the trait are shown in table 1. The overall mean of abortion was 5.80% (Table 1). However, the estimate was in close agreement with results obtained by Risco *et al.,* (1999) in United States of America and McDouqall *et al.,* (2005) in New Zealand, but in the same time the estimate refers to exist of a problem which needs to resolve in this herd. Bagley, (1999) thought that if abortion rate increases to 3 to 5% that should be of some concern and manager should begin to make efforts to obtain a diagnosis.

TABLE 1 Least square means ± S.E for abortion in Holstein cows

Least square means ± S.E	No. of observations	Factors
Overall mean	17787	5.80 ± 0.17
Calving season		
Winter	4926	4.80 ± 0.35 b
Spring	3102	7.00 ± 0.44 a
Summer	4649	7.49 ± 0.36 a
Autumn	5110	5.75 ± 0.34 a
Calving year		
1990 and lower	317	6.79 ± 1.34 ab
1991	331	4.82 ± 1.36 b
1992	368	7.26 ± 1.22 ab
1993	670	6.84 ± 0.91 ab
1994	837	8.13 ± 0.81 a
1995	942	7.33 ± 0.76 ab
1996	975	8.15 ± 0.74 a
1997	1443	5.30 ± 0.62 b
1998	1694	7.60 ± 0.57 a
1999	1787	6.56 ± 0.55 ab
2000	1829	5.60 ± 0.54 ab
2001	1870	5.67 ± 0.53 ab
2002	1880	4.82 ± 0.53 b
2003	1615	4.21 ± 0.58 b
2004	1229	3.65 ± 0.67 b
Parity		
1	4026	5.94 ± 0.37 a
2	4024	5.31 ± 0.37 a
3	3292	6.61 ± 0.42 a
4	2437	6.43 ± 0.49 a
5	1690	6.36 ± 0.58 a
6 and more	2318	6.91 ± 0.51 a
Age at first calving		
29 months and lower	5427	6.76 ± 0.32 a
30 – 33	6419	6.01 ± 0.33 a
34 months and more	5941	6.01 ± 0.34 a
Gender		
Male	9115	6.66 ± 0.27 a
Female	8672	5.86 ± 0.28 a

Means in the same column with no common superscripts differ significantly (P < 0.01).

TABLE 2 Analysis of variance of some factors affecting abortion in Holstein cows

Sources of variation	d.f	Mean squares
Calving season	3	6747.02 **
Calving year	14	2139.63 **
Parity	5	1010.89
Age at first calving	2	991.99
Sex of calf	1	898.97
Residual	17761	536.01

** ($P < 0.01$)

TABLE 3. Least square means ± S.E for offspring sex ratio in Holstein cows

Least square means ± S.E	No. of observations	Factors
Overall mean	17787	51.05 ± 0.42
Conception season		
Winter	4901	51.58 ± 0.91 a
Spring	3127	53.36 ± 1.12 a
Summer	4620	51.65 ± 0.95 a
Autumn	5139	50.45 ± 0.90 a
Conception year		
1989 and lower	302	51.09 ± 2.97 ab
1990	346	52.72 ± 2.88 a
1991	362	49.90 ± 2.67 ab
1992	676	51.99 ± 2.03 a
1993	817	54.38 ± 1.82 a
1994	962	53.83 ± 1.79 a
1995	950	54.07 ± 1.78 a
1996	1468	54.69 ± 1.48 a
1997	1680	49.75 ± 1.36 ab
1998	1801	49.26 ± 1.32 ab
1999	1801	51.66 ± 1.31 a
2000	1898	47.95 ± 1.30 b
2001	1823	50.59 ± 1.36 ab
2002	1645	49.12 ± 1.57 b
2003	1216	55.44 ± 3.58 a
Parity		
1	4026	51.37 ± 0.85 a
2	4024	51.31 ± 0.93 a
3	3292	52.30 ± 1.06 a
4	2437	53.33 ± 1.25 a
5	1690	51.13 ± 1.60 a
6 and more	2318	51.22 ± 1.51 a
Age at first calving		
29 months and lower	5427	51.65 ± 0.81 a
30 – 33	6419	52.26 ± 0.89 a
34 months and more	5941	51.37 ± 0.91 a
Calving interval		
365 days and lower	4782	51.81 ± 0.93 ab
366 – 450	5780	52.27 ± 0.85 a
451 – 535	3336	53.44 ± 1.11 a
536 days and more	3889	49.53 ± 1.00 b

Means in the same column with no common superscripts differ significantly ($P < 0.05$).

Mean-squares and significance of different sources of variation in the model fitted by analyzing abortion trait is shown in table 2. The variation in abortion due to season of calving was significant ($P < 0.01$). The highest abortion ratio in summer (7.49%) and spring (7.00%), whereas the lowest in winter (4.80%) and autumn (5.75%). The significant differences between estimates may belonged to high temperature degrees which could caused heat stress and abortion in animals. Hovingh, (2002) reported that heat stress can affect reproductive performance in a dairy herd, although it will generally cause conception problems rather than abortions. While there is some evidence to suggest that

a very sudden increase in environmental temperature may result in abortion, there is little evidence to support heat stress as a common cause of abortion. Jordan, (2003) reported that negative effects of heat stress have been identified from 42 d before to 40 d after insemination which was representing synchronization between heat stress and each of early and late abortion. The present study indicated that year of calving had significant effect ($P < 0.01$) on this trait, highest estimates (8.15%) in 1996 and lowest (3.65%) in 2004, these differences reflect the unstable of management level, nutrition and herd size, it was noticed that number of offspring was increased dramatically from 1999 to 2002 and then the number decreased during the period 2003 – 2004 and that's the same to what happened to the abortion trend.

Weigel *et al.,* (2002) reported that increasing in herd size caused depression in management level and as a result we expected that the abortion ratio increased. The abortion of different parities and age at first calving varied, but there were no significant effect of these two factors on this trait. Similar results concerning the first factor were obtained by Risco *et al*., (1999) and Jousan *et al.,* (2005). The abortion estimated in males and females were 6.66% and 5.86% respectively but the differences between them were not significant. Table 3 shows that overall means of sex ratio (proportion of male to female) was 51.08% which is fall within range (49.9 - 53.97%) reported by numerous researches (Fisher, 1979; Osei *et al.,* 2002 and Roche *et al.,* 2006).

TABLE 4. Analysis of variance of some factors affecting offspring sex ratio in Holstein cows

Sources of variation	d.f	Mean squares
Conception season	3	3874.29
Conception year	14	4812.60 *
Parity	5	1391.18
Age at first calving	2	928.18
Calving interval	3	7865.55*
Residual	17759	2496.22

*($P < 0.05$)

The effect of conception year on sex ratio was significant at $p < 0.05$ (Table 4), the highest estimates were in 1997 (53.99%) and the lowest in 1999 (49.87%), the differences may be due to unequal number of embryonic deaths, abortions and stillbirths among years (Rosenfeld and Roberts, 2004). The results in the present study showed that the trait differ significantly ($P < 0.05$) due to the length of calving interval. The sex ratio increased as calving interval increased. This finding supports those of Joakimsen, (1975) who found similar results. The effect of other factors was not significant which is in close agreement with the results obtained by Foote, (1977).

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