The Journal of Animal & Plant Sciences, 20(3), 2010, Page: 164-169
ISSN: 1018-7081

DETERMINATION OF SOME ENVIRONMENTAL FACTORS RELATED TO SEX RATIO OF BROWN SWISS CALVES

I. Yilmaz, E. Eyduran and A. Kaygisiz*

Igdir University, Faculty of Agriculture, Department of Animal Science, 76000, Igdir-Türkiye
*Kahramanmaras Sutcu Imam University, Faculty of Agriculture, Department of Animal Science, Kahramanmaras-Türkiye
Corresponding Author: ecevit.eyduran@gmail.com

ABSTRACT

The aim of this study is to determine the environmental factors related to *sex* of calves born from Brown-Swiss cattle reared at Malya (M) and Konuklar (K) State Farms in Türkiye. A total of 7055 calves (1861 calves for K and 5194 calves for M state farms) were used as animal material. Unlike previous studies, a new ratio called "*Relative Female Ratio (RFR)*" (the superiority of female to male calves) was firstly suggested in this study for dairy cattle. The data on sex of all these calves, calving year, season, and parity of their dams were recorded. By using G statistic, an alternative of Pearson Chi-Square statistic, (which test an association between two categorical variables), calving year-sex, calving season-sex, parity-sex and sire-sex associations were examined for these two state farms. The proportions of male and female calves born in K and M state farms were 50.05:49.95 and 52.47:47.53, respectively. RFR values for K and M state farms were 0.998 (942 female calves/944 male calves) and 0.906 (2474 female calves/2731 male calves).When all the calves were taken into consideration, no significant association between state and sex was found. In K state farm, when probabilities of G statistic were examined, calving year-sex, calving season-sex, parity-sex, and sire-sex associations were non-significant. In M state farm, according to probabilities of G statistic, only calving year-sex association was found to be important ($P<0.05$), but calving season-sex, parity-sex and sire-sex associations were non-significant. As a result, it is hoped that results obtained from the current study will be beneficial for later scientific studies to be conducted on Secondary Sex Ratio (SSR) and RFR in the future.

Key Words: Secondary sex ratio, dairy cattle, Relative Female Ratio (RFR).

INTRODUCTION

In recent years, determination of sex ratio with biotechnological applications such as super ovulation, in vitro fertilization, in vitro embryo production, embryo division, and embryo transfer has been of great importance in dairy industry (Kaygisiz *et. al.,* 2003). In long-term, profitability of milk production may be increased with increasing female calving ratio. Genetically manipulations related to sex ratio are inevitable with aim of increasing female calving ratio for milk production. In other words, when pre-determination and intervention of sex ratio are made, more important results are expected to improve milk production.

Probability theory indicates that the secondary sex ratio (SSR), the ratio of male to female offspring at birth, should be 50:50 in respect of evolutionary equilibrium (Roche *et. al.,* 2006). In non-human mammals, SSR of newborn offspring was influenced by many factors such as litter size, maternal age, maternal parity, mother's milk yield, maternal stress, birth type, birth season, time of insemination, inbreeding levels, managerial conditions, and population demography (Demiral *et al.,* 2007). It was remarked that body condition scores had positive effect on SSR (Roche *et al.,* 2006).

Some authors also reported that breed, sire, season, parity, and year may be effective factors on sex ratio (Singh *et al.,* 2004; Kaygisiz and Vanli, 2008). Lari (2006) deserved a significant effect of sex hormone levels of dam on sex ratio. It was also reported that there was a positive significant relationship between herd size and sex ratio (Farahvash *et. al.,* 2008). There has been a growing concern about determination of sex ratio of calves born in dairy cattle. But little reports on SSR are available in Turkiye. Hence, this study was conducted to determine the association between each environmental factor (calving year, calving season, and parity) and sex of Brown Swiss calves newborn in Konuklar and Malya State farms. In the current study, we developed a new ratio "Relative Female Ratio" (%) for dairy cattle. In this way, results of the current study will contribute to subsequent studies to be carried out on SSR and RFR in future.

MATERIALS AND METHODS

The data were collected from Brown Swiss calves born in Konuklar (K) (1861 calves) during 1990-

2007 and Malya (M) (5194 calves) state farms during 1987-2008. However, records of six years (1987, 1988, 1989, 2003, 2004, and 2008) were not available in Konuklar state farm.

In the present study, all the available records on sex of Brown Swiss calves, calving year, season, and parity of their dams were used. Calving season was defined as Winter (December, January, February), Spring (March, April, May), Summer (June, July, August) and Autumn (September, October, November).

As reported by Mora *et al.,* (2010), Secondary sex ratio (SSR) is (A/C)*100: (B/C)*100. That is, it was defined as the number of males divided by the total number of individuals (males / [males+females]).
Where,

A: The number of male calves
B: The number of female calves
C: The number of total calves (A + B)

As regards dairy cattle, "Relative Female Ratio" (B/A) was described as the superiority of female to male in the current study. A new ratio with title "Relative Female Ratio" (RFR) derived from numbers of female and male calves were developed for dairy cattle. Numbers of male and female calves become equal to each other when RFR =1. Number of female calves is more than that of male when RFR > 1. Number of male calves is more than that of female when RFR < 1.

In order to determine the association between sire and sex, sires with more than 30 calves were evaluated.

Statistical Analysis

Chi-Square and G (Likelihood Ratio Chi-Square) statistics show the chi-squared distribution. G statistic is an alternative of Pearson's Chi-Square statistic in categorical data analysis, especially two-way tables. G statistics for each farm were used to determine associations between:

State and sex; calving year and sex; calving season and sex; parity and sex and sire and sex.
In this study, for example, "calving year-sex" is the same with "association between calving year-sex" and "calving year by sex".

Chi-Square (1) and Likelihood Ratio Chi-Square statistics (2) can be written with the following equations:

$$\chi^2 = \sum \frac{(f - f_i)^2}{f_i} \quad (1)$$

$$G = 2\sum f.\ln\left(\frac{f}{f_i}\right) \quad (2)$$

Where, f, observed frequency and f_i , expected frequency (Eyduran, 2008).

"Row percent" in Tables means the ratio of columns within a row.

The relative female ratio obtained from numbers of female and male calves were analyzed using analysis of variance at Randomized Complete Block Design.

The effects of farm and calving year farm and calving season and form and parity were also determined on RFR.
ANOVA at randomized complete block design was used since too few observations were within many sub-groups which consisted of farm, parity, calving season, and calving year.
All the statistical analyses were performed with MINITAB (15. Released Version) statistical package program.

RESULTS AND DISCUSSION

Table 1 describes the relationship between state and sex. When all the calves born in K and M state farms were considered, the association between state and sex was insignificant according to G statistic, found as 3.24. In K state farm, the male ratio (50.05%) of calves born was almost similar to the female ratio (49.95%). The male ratio of calves born in M state farm was a bit higher than the female one. RFR values for K and M state farms were 0.998 (942/944) and 0.906 (2474/2731). Corresponding value for all the calves were estimated as 0.930 (3416/3675). These three RFR values revealed that number of male calves was a bit more than that of female ones. As can be seen from Table 1, when all the calves were examined, observed ratio of male ratio was 1.83% more than expected ratio of female calves. In this case, relative surplus of male calves was found 3.66 % compared to female calves.

Table 1. Two-way table of state by sex

FARMS	N/Percent	SEX	
		Male	**Female**
KONUKLAR	Frequency	944	942
	Row Percent	50.05	49.95
MALYA	Frequency	2731	2474
	Row Percent	52.47	47.53
Total	Frequency	3675	3416
	Row Percent	51.83	48.17
G Statistic= 3.24^{NS} (df = 1)			

NS: Non-significant
Row Percent is the ratio of columns within a row.

Two-way tables of calving year by sex for K and M state farms are illustrated in Table 2. G statistic values, used to determine an association between calving and year were obtained 12.99 in K state farm and 33.12 ($P<0.05$) in M state farm (Table 2). On the other hand, when probabilities of G statistic were examined (Table 2), the association between calving year and sex for K

Table 2. Two way-table of calving year by sex for each farm

KONUKLAR State Farm				MALYA State Farm			
YEAR	**N/Percent**	**SEX**		**YEAR**	**N/Percent**	**SEX**	
		Male	**Female**			**Male**	**Female**
-	-	-	-	1987	Frequency	15	16
-	-	-	-		Row Percent	48.39	51.61
-	-	-	-	1988	Frequency	58	46
-	-	-	-		Row Percent	55.77	44.23
-	-	-	-	1989	Frequency	83	70
--	-	-	-		Row Percent	54.25	45.75
1990	Frequency	5	12	1990	Frequency	95	67
	Row Percent	29.41	70.59		Row Percent	58.64	41.36
1991	Frequency	24	20	1991	Frequency	119	72
	Row Percent	54.55	45.45		Row Percent	62.30	37.70
1992	Frequency	37	34	1992	Frequency	113	95
	Row Percent	52.11	47.89		Row Percent	54.33	45.67
1993	Frequency	43	36	1993	Frequency	113	111
	Row Percent	54.43	45.57		Row Percent	50.45	49.55
1994	Frequency	58	61	1994	Frequency	114	127
	Row Percent	48.74	51.26		Row Percent	47.30	52.70
1995	Frequency	86	69	1995	Frequency	125	113
	Row Percent	55.48	44.52		Row Percent	52.52	47.48
1996	Frequency	100	89	1996	Frequency	114	138
	Row Percent	52.91	47.09		Row Percent	45.24	54.76
1997	Frequency	102	124	1997	Frequency	144	142
	Row Percent	45.13	54.87		Row Percent	50.35	49.65
1998	Frequency	128	133	1998	Frequency	144	111
	Row Percent	49.04	50.96		Row Percent	56.47	43.53
1999	Frequency	141	151	1999	Frequency	131	125
	Row Percent	48.29	51.71		Row Percent	51.17	48.83
2000	Frequency	165	160	2000	Frequency	156	138
	Row Percent	0.77	49.23		Row Percent	53.06	46.94
2001	Frequency	19	21	2001	Frequency	159	117
	Row Percent	47.50	52.50		Row Percent	57.61	42.39
2002	Frequency	2	6	2002	Frequency	145	141
	Row Percent	25.00	75.00		Row Percent	50.70	49.30
-	-	-	-	2003	Frequency	124	141
	-	-	-		Row Percent	46.79	53.21
-	-	-	-	2004	Frequency	162	139
	-	-	-		Row Percent	53.82	46.18
2005	Frequency	7	5	2005	Frequency	169	163
	Row Percent	58.33	41.67		Row Percent	50.90	49.10
2006	Frequency	14	9	2006	Frequency	199	159
	Row Percent	60.87	39.13		Row Percent	55.59	44.41
2007	Frequency	13	12	2007	Frequency	171	152
	Row Percent	52.00	48.00		Row Percent	52.94	47.06
-	-	-	-	2008	Frequency	78	91
	-	-	-		Row Percent	46.15	53.85
Total	**Frequency**	**944**	**942**	**Total**	**Frequency**	**2731**	**2474**
	Row Percent	**50.05**	**49.95**		**Row Percent**	**52.47**	**47.53**
G Statistic value: 12.99^{NS} (df=15)				G Statistic value: 33.12* (df=21)			

NS: Non-significant *: P<0.05

state farm was insignificant, whereas significant association for M state farm was determined (P<0.05). Finding of Farahvash *et al.,* (2008), who studied on Holstein or crossbred herds in East Azarbijan, was in line with the result obtained from M state farm but not in agreement with that obtained from K state farm. The sex ratios changed from year to year and was dependent on year as reported by Farahvash *et al.,* (2008) and Sing *et al.,* (2004). Result taken from K state farm was in agreement with findings of Kaygisiz *et al.* (2003), who found that there was not a significant association between calving year and sex for Holstein cattle in Bursa province, Turkiye. In an investigation conducted on Karan Swiss cows by Mukherjee *et al.,* (2000), no significant effect of year on sex ratio was found. Biradar and Suranagi (2003) mentioned that calving year didn't affect sex ratio of Deoni cows. Similar findings were obtained in Calves of Jersey × Sindhi crossbred cows (Birader, 1996).

Average RFR of M state farm was higher than that of K state farm (P<0.01). However, the effect of calving year factor on RFR was insignificant (data not shown).

Table 3: Two way-table of calving season by sex for each farm

SEASON	N/Percent	Konuklar State Farm		Malya State Farm	
		SEX		SEX	
		Male	Female	Male	Female
Spring	Frequency	249	266	740	671
	Row Percent	48.35	51.65	52.45	47.55
Summer	Frequency	308	300	889	759
	Row Percent	50.66	49.34	53.94	46.06
Autumn	Frequency	196	182	571	559
	Row Percent	51.85	48.15	50.53	49.47
Winter	Frequency	191	194	531	485
	Row Percent	49.61	50.39	52.26	47.74
Total	**Frequency**	**944**	**942**	**2731**	**2474**
	Row Percent	**50.05**	**49.95**	**52.47**	**47.53**
		G Statistic value: 1.21^{NS} (df =3)		G Statistic value: 3.16^{NS} (df =3)	

NS: Non-significant

Two-way tables of calving season by sex for K and M state farms are given in Table 3. G statistic values were found 1.21 and 3.16 for K and M state farms with aim of determining association between calving season and sex in these farms. Association between calving season and sex for each farm was insignificant in respect of probabilities of G statistic (Table 3). The findings of the present study were in consistent with finding of Lari (2006) who reported no significant association between season and sex. Roche *et al.,* (2006) reported that season effect on SSR was uncertain in dairy cattle. However, Singh *et al.,* (2004), explained that calving season affected sex ratio insignificantly.

In M state farm, ratios of the male calves born in all the seasons were slightly higher than female calves while ratios of the male calves born in summer and autumn seasons were a bit higher than ratios of the female calves born.

When RFR values were calculated individually for each season and farm, the effects of farm and calving year on RFR with Randomized Complete Block Design were considered. not significant (data not shown).

Two-way table of parity by sex for K and M state farms are presented in Table 4. G statistic values calculated for testing association between parity and sex were 7.31 for K state farm and 6.10 for M state farm. As shown in Table 4, no significant association between parity and sex for each farm was found with respect to probabilities of these G statistic values.

These results from two farms were in agreement with findings of Roche *et al.* (2006), Kaygisiz *et al.* (2003) and Lari (2006), who also stated a non-insignificant association between calf sex and parity. In Karan Swiss cows, it was stated that the effect of parity on sex ratio was not significant (Mukherjee *et. al.,* 2000).

However, results of the present study were not consistent with Singh *et al.,* (2004), who stated that sex was influenced by parity. The effect of year on sex ratio of Calves of Jersey × Sindhi crossbred cows was found insignificant (Birader, 1996).

After RFR values were estimated singly for each parity and farm, these RFR values was analyzed using Randomized Block Design, It was determined that the effects of farm and parity on the trait were insignificant (data not shown).

According to G statistic probabilities, the association between sire and sex for each farm were insignificant. These findings were in agreement with those reported by Kaygisiz *et al.,* (2003) (data not shown).

Table 4: Two way-table of parity by sex for each farm

PARITY	N/Percent	Konuklar State Farm		Malya State Farm	
		SEX		SEX	
		Male	Female	Male	Female
1	Frequency	327	305	738	697
	Row Percent	51.74	48.26	51.43	48.57
2	Frequency	243	246	648	570
	Row Percent	49.69	50.31	53.20	46.80
3	Frequency	158	167	486	412
	Row Percent	48.62	51.38	54.12	45.88
4	Frequency	88	97	340	277
	Row Percent	47.57	52.43	55.11	44.89
5	Frequency	52	70	214	217
	Row Percent	42.62	57.38	49.65	50.35
6	Frequency	45	37	146	146
	Row Percent	54.88	45.12	50.00	50.00
7	Frequency	31	20	159	155
	Row Percent	60.78	39.22	50.64	49.36
Total	**Frequency**	**944**	**942**	**2731**	**2474**
	Row Percent	**50.05**	**49.95**	**52.47**	**47.53**
		G Statistic value: 7.31^{NS} (df=6)		G Statistic value: 6.10^{NS} (df=6)	

NS: Non-significant

Conclusions: Sire, age of sire, parity, calving year, calving season, climate, insemination time, and maternal factors (age, stress etc.) might effect secondary sex ratio at birth in dairy cattle. In current study, an association between calving year and sex in M state farm was significant ($P<0.05$) but insignificant in K state farm. Also, sire, parity and calving season was not statistically connected with sex.

In the current study, a new relative ratio called "Relative Female Ratio (RFR)" (defined as the superiority of female to male) was firstly suggested. When values of RFR which was firstly suggested were used, RFR values of K and M state farms were 0.998 and 0.906. This value obtained from all the calves was found 0.930 (3416/3675). RFR showed clearly that numbers of male were slightly more than those of female ones.

With respect to ANOVA at Randomized Block Design, When the effects of farm and calving year on RFR were evaluated, only farm factor had significant effect on RFR ($P<0.01$). When the effects of farm and calving season on RFR were examined, the effects of farm and calving season were insignificant. When the effect of farm and parity on RFR were tested, the effects of farm and calving season were not significant.

As a result, it is hoped that results obtained from the current paper will be beneficial for later scientific studies to be conducted in the future.

REFERENCES

Biradar, U. S. (1996). Sex ratio in a closed herd of Jersey x Sindhi crossbred cattle. J. Dairying, Foods and Home Sci. 15 (1): 69-70.

Biradar, U. S., and M. D. Suranagi (2003). Effect of seasons and periods of birth on sex ratio in Deoni cattle. Karnataka J. Agr. Sci.16 (2): 335-336.

Demiral, O., M. Ün, M. Abay, and T. Bekyürek (2007). The effect of artificial insemination timing on the sex ratio of offspring and fertility in dairy cows. Turk. J.Vet.Anim. Sci. 31 (1): 21-24.

Eyduran, E. (2008).Usage of penalized maximum likelihood estimation method in medical research: An alternative to maximum likelihood estimation method. J. Res. Med.Sci.13(6):325-330.

Farahvash, T. S., G. Adabi, A. Ahmadzadeh, and J. Davoodi (2008). Some factors affecting sex ratio of dairy herds in East Azarbijan, Iran. Asian J. Anim. Vet. Advances. 3 (5): 357-362.

Kaygisiz, A., Y. Vanli, and L. Cakmak (2003). Estimates of genetic and phenotypic parameters of sex ratio in Holsytein Cattle. GAP III.Agricultural Congress, Şanliurfa, Türkiye.

Kaygisiz, A., and Y. Vanli (2008). Factors influencing sex ratio in Brown Swiss Cattle. Indian J. Anim. Sci. 78(6): 656-657.

Lari, M. A. (2006). Sex ratio at birth in dairy herds in Fars province, southern Iran. Trop. Anim. Health Prod.38(7-8): 593-595.

MINITAB 15.Trial Version www.minitab.com .

Mora, O., M.D.M. Delgado, and V. Penteriani (2010). Secondary sex ratio in eurasian eagle-owls: Early breeding females produce more daughters. J. Raptor. Res. 44(1): 62-65.

Mukherjee, K. S. S. Tomar, and R. B. Singh (2000). Variability in sex ratio in Karan Swiss cattle. Indian J. Anim. Res. 34 (1): 24-28.

Roche, J. R., J.M. Lee, and D. P. Berry (2006). Climatic factors and secondary sex ratio in dairy cows. J. Dairy Sci.89:3221-3227.

Singh, B., D. Kumar, H. Singh, R. B. Prasad, and J. B. Singh (2004). Genetic studies on sex ratio in dairy cattle. Indian J. Anim. Sci. 74 (9):986-988.