Genetic and environmental factors affecting on birth and weaning weight in Brown Swiss cattle

***S.** Zakizadeh*[1], A. Rahimi[1].

Introduction

Birth weight (BW) plays an important economical role because of its relation to calving ease, weaning weight (WW), gain and the calf/heifer performance in future. It could be also as an indicator for predicting weaning weight, which is much more important in beef cattle rather than dairy breeds. Previous works have reported genetic and environmental factors influencing on birth and weaning weight, such as year and season of birth, sex of calf and age of dam (Wilson 1973; Sellers *et al.* 1970; Minyard and Denkel 1965). Heritabilities have ranged from 0.38 to 0.58 (Brotherstone *et al.* 2007; Coffey *et al.* 2006; Groen and Vos 1995; Arango *et al.* 2002; Aziz *et al.* 2005; MacNeil 2005; Wilson 1973) for BW, and from 0.45 to 0.59 (Coffey *et al.* 2006; Brotherstone *et al.* 2007) for WW, regarding to breed of calves. The aims of this study were to: 1) investigate environmental factors influencing on BW and WW; 2) estimate direct and maternal heritabilities of BW and WW, and 3) estimate genetic, phenotypic and environmental correlations between BW and WW in Brown Swiss cattle in the Northeast of Iran.

Material and methods

A dataset collected from 2 Brown Swiss farms in Northeast of Iran during 1999-2009 was used for this study. These farms were the oldest and well-known farms (>40 yrs), which had been rearing pure registered Brown Swiss cattle in Iran. Weights were taken at birth and weaning (age at weaning was 57.38 d averagely, with a standard deviation of 10.77 d). There was not any record for weaning weight in one of the farms, therefore WW decreased to 600 samples. Linear regression models included herd-year-season, sex, and parity of dam for BW. The same model was considered for WW records, including suckling period and BW as covariates. Data were analyzed by JMP software (V. 4.0.4). Animal model was used to estimate genetic parameters, such as heritability and correlations, by DFREML models 1, 2, 3, 4, 7 and 8 for single traits separately and 1, 2, 3 and 7 for two-trait analysis. Model 1 was the simplest model which considered the effects of additive genetics and environmental factors, cited above, regarding to each trait. Permanent environment was considered in model 2. Models 3 and 4 included maternal effects, but model 3 did not consider covariance between maternal and direct maternal genetic effects. Models 7 and 8 were the same as models 3 and 4 but they included effect of permanent environment too.

Results and discussion

Herd, year and season of birth, sex and parity of dam had highly significant effect on birth weight (Table 1). Year and season of birth, birth weight and suckling period were significant on WW ($p<0.01$). Sex had significant effect on WW ($p<0.05$), but parity of dam was not significant.

[1] Hasheminejad higher education center. 9176994767. Mashhad, Iran

The effect of herd and year could be due to different managements of rearing and/or feeding in farms. Calves which gave birth in winter (22 Dec. to 21 Mar.) had the highest weight for BW and WW. Seller *et al.* (1970) found the effect of year was highly significant on BW, indeed calves born in winter and spring had higher weaning weight rather than those born in fall or summer. Least square mean showed BW and WW increased up to the 5^{th} parity of dam and then decreased. Minyard and Dinkel (1965) reported maximum production could be reached at 8 years of age of beef dams, but Wilson (1973) found no significant differences between birth weights of calves from 2-, 3- or 4-year-old dams. Male calves had higher BW (42.21 vs. 40.34 kg), but females showed heavier WW (68.97 vs. 64 kg), although their suckling period was shorter (54.96 vs. 60.27 d). Seller *et al.* (1979) reported bulls were heavier in weaning weight as age of dam increased through 5 years of age. Suckling period showed significant effect on WW in this study. Minyard and Dinkel (1965) reported that age of Hereford and Angus calves had highly significant effect on weaning weight, which it could be implicated as suckling period.

Estimated heritability for direct effect of BW ranged from 0.247 to 0.34 and from 0.162 to 0.17 for weaning weight (Table 2), when univariate analysis was used for each trait separately. Our results differed somehow from previous reports who worked on different breeds. Brotherstone and *et al.* (2007) estimated body weight heritability from birth to 1000 days of life and reported 0.58±0.78 at birth day and 0.59±0.04 at 50^{th} day. Coffey *et al.* (2006) used a multivariate analysis and estimated heritabilities of 0.53 and 0.45 for birth and weaning weights, respectively Aziz and *et al.* (2005) worked on a Japanese Black herd and reported 0.38 for birth weight's heritability. Direct and maternal heritabilities of weaning weight were estimated 0.4±0.02 and 0.19±0.02 by Splan *et al.* (2002), respectively. Our study showed that maternal effect was only significant for BW, and maternal heritability was 0.06. As dairy calves were separated from their dams early after birth, it would be the reason why maternal effect had no significant effect on WW. Aziz and *et al.* (2005) estimated 0.04 for maternal genetic heritability in Japanese Black calves. Other study reported 0.46±0.04 and 0.1±0.02 for direct and maternal heritability of BW in a beef farm, respectively (MacNeil, 2005). Heritability, genetic, phenotypic and environmental correlations are shown in table 3. Brotherstone and *et al.* (2007) estimated 0.6±0.062 for genetic correlation between birth weight and weight at 50^{th} day. Coffey *et al.* (2006) estimated 0.73±0.03 and 0.79±0.09 for phenotypic and genetic correlations between BW and WW, respectively. Estimated phenotypic trend of BW (two herds) and WW (one herd) was positive since 2005 (Figure 1).

Table 1: Probability values of BW and WW in univariate models analyzed by JMP

Source	**Prob > F**	
	Body Weight:	**Weaning Weight:**
Herd	<.0001	---
Parity	<.0001	0.7767
year-brt	0.0003	<.0001
Season-brt	<.0001	0.0002
Sex	<.0001	0.0101
Birth weight	---	<.0001
Suckling period	---	0.0088

Table 2: Heritability (h^2) and standard error (SE) for single trait analysis of BW and WW

Model	BW		WW	
	h^2	SE	h^2	SE
1	0.345	0.011	0.170	0.094
2	0.294	0.061	0.170	0.000
3	0.247	0.065	0.170	0.000
4	0.277	0.084	0.163	0.094
7	0.254	0.024	0.170	0.000
8	0.287	0.027	0.162	0.000

Table 3: Heritability (h^2), genetic (r_g), phenotypic (r_p) and environmental (r_e) correlations of BW and WW

Model	H^2-BW	h^2-WW	r_g	r_p	r_e
1	0.330	0.106	0.490	0.014	0.137
2	0.255	0.105	0.603	0.008	0.138
3	0.241	0.103	0.574	0.021	0.148
7	0.254	0.104	0.601	0.010	0.140

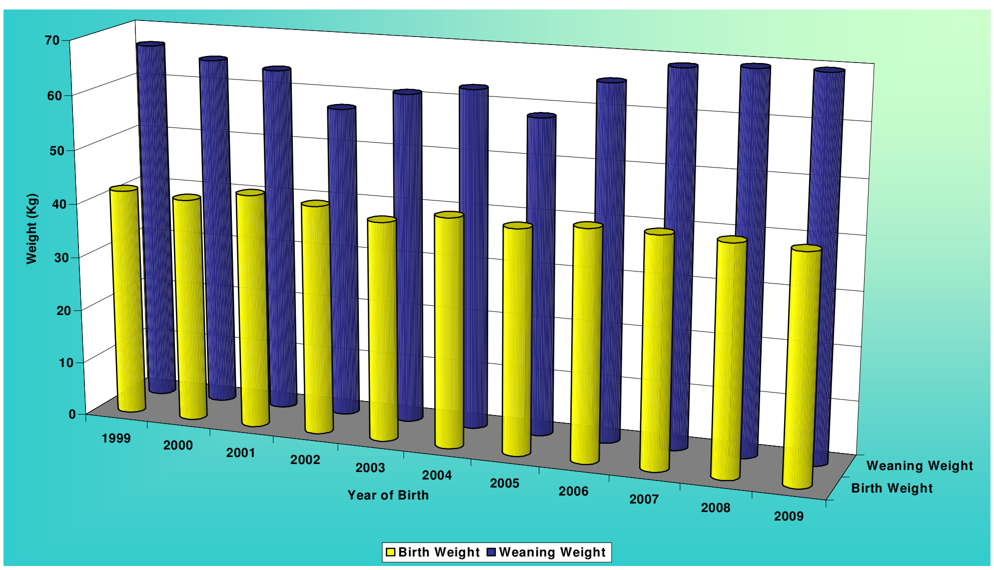

Figure 1: Estimated phenotypic trends for birth and weaning weights 1999-2009

Conclusion

The analysis has shown that birth and weaning weights of calf are heritable characteristics, which were influenced by many factors. The major factors were the year-season of birth, sex of the calf, age of dam and suckling period. It seems that birth during the cold-weather seasons could produce heavier calves in both sexes. As the Northeast of Iran is located in a hot and dry area, heat stress could influence on birth and weaning weights. Male calves weighed more at birth than female calves. Calves were heavier at birth and weaning date, as the age of dam increased through 5 lactation number. Estimated correlations showed relation between BW and WW. As we used a different breed in compare with previous literatures, and also because of small number of records, our genetic parameters could be affected by sampling error; therefore it could not be expected to be in consistent with the work of previous studies.

References

Arango J. A., L. V. Cundiff and L. D. Van Vleck. 2002. *J Anim Sci.* 80:3112-3122.
Aziz, M. A., S. Nishida, K. Suzuki, and A. Nishida. 2005. *J. Anim. Sci.* 83:519–530.
Brotherstone, S., Coffey, M. P., and G. Banos. 2007. *J. Dairy Sci.* 90:444–450.
Coffey M. P., J. Hickey, and S. Brotherstone. 2006. *J. Dairy Sci.* 89:322–329.
MacNeil, M. D. 2005. *J. Anim. Sci.* 83:794-802.
Minyard J. A. , and C. A. Dinkel. 1965. *J. Anim. Sci*. 1965. 24:1067-1071.
Sellers H. I., R. L. Willham and R. C. DeBaca. 1970. *J. Anim. Sci.* 31:5-12.
Splan R. K., L.V. Cundiff, M. E. Dikeman and L. D. VanVleck.2002. *J Anim. Sci.* 80:3107-3111.
Wilson, L.L.. 1973. *J. Animal Sci.* 36: 452-456.