Journal of Animal and Veterinary Advances 9 (17): 2275-2278, 2010
ISSN: 1680-5593

Estimates of Genetic and Phenotypic Parameters on Birth Weight of Crossbred Cattle Raised under Organized Farm Conditions

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Abstract: A study was conducted to assess the influence of certain genetic and non-genetic factors on the birth weight and to estimate the genetic and phenotypic parameters of birth weight in crossbred calves raised under organized farm conditions. The data on performance record of 713 calves born over a period of 11 years from 1995-2005 at Cattle Breeding Farm, Thumburmuzhy, Kerala was statistically analyzed using the mixed model least square and Maximum likelihood computer program PC-2 of Harvey. The least square mean for birth weight of calves was found to be 27.83±0.48 kg. The male calves (28.50 kg) were found to be heavier than the female calves (27.16 kg).

Key words: Birth weight, crossbred cattle, heritability, non-genetic factors, India

INTRODUCTION

The main body of cattle now kept in Kerala state of India is crossbred of various degrees between indigenous and exotic breeds viz., Jersey, Holstein Friesian and Brown Swiss. The crossbreeding programme of the state is aimed at improving the genetic potentiality of the animals for milk production by increasing the proportion of high yielding crossbred cattle and enhancing the reproductive efficiency of the female stock. The knowledge on the various economic traits of the crossbred cattle of the state is highly essential to achieve this goal through planned breeding and systematic genetic selection. The birth weight of the calf is one of the important economic traits of the cattle which has a direct bearing on subsequent growth rate and milk production. Farrel (1993) suggested that birth weights lower than the optimum are associated with reduced energy reserves, lowered thermo regulatory capability and increased calf death at or near birth. Low birth weight is also related to low rates of growth after birth and decreased mature size. Conversely birth weights greater than optimum are associated with greater calving difficulty, calf losses at birth and increased difficulties with rebreeding the cow. Besides these extremes, heifers having optimum high birth weight grow fast and reach mature weight to produce offspring at an earlier age and subsequently, milk production. Even though information on the birth weight of various indigenous breeds are available in plenty study on the birth weight of crossbred cattle is found to be scanty. Hence the present study was undertaken to assess the influence of certain genetic and non-genetic factors on the birth weight and to estimate the genetic and phenotypic parameters of birth weight in crossbred calves raised under organized farm conditions.

MATERIALS AND METHODS

The data for the present study were collected from the performance records of the calves born over a period of 11 years from 1995-2005 at Cattle Breeding Farm, Thumburmuzhi, Kerala, India. The birth weights of 713 crossbred calves born to 70 sires were utilized to study the effect of sire, sex of calf, year of calving, season of calving, parity of dam and gestation length of dam. All birth weights were obtained within twelve hours following birth. Data on normal births and normal calves only were considered for the study.

To study the effect of season of calving on birth weight the calendar year was divided into three seasons as summer (February-May), Rainy (June-October) and winter (November-January) after Mathai and Raja (1976). In order to study the effect of gestation length on birth weight of calves the gestation period of cows was grouped into five classes viz., gestation period below 271 days, 271-275 days, 276-280 days, 281-285 days and gestation above 285 days as suggested by Mathai *et al.* (1978). The parity of the dam was classified in to six groups viz., 1st, 2nd, 3rd, 4th, from 5-9 and >9 as mentioned by Goyache *et al.* (2002).

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Statistical analysis: Birth weight of calves was analyzed using the Mixed Model Least Square and Maximum Likelihood computer program PC-2 of Harvey (1990). The statistical model used in the present study is as follows:

$$X_{ijklmno} = \mu+S_i+a_j+b_k+c_l+d_m+g_n+e_{ijklmno}$$

Where:

$X_{ijklmno}$ = Observation corresponding to the ith sire, jth sex, kth year, lth season, mth parity and nth gestation period
μ = General mean
S_i = Effect of ith sirei = 1-70
a_j = Effect of jth sexj = 1 and 2
b_k = Effect of kth yeark = 1995-2005
c_l = Effect of lth seasonl = 1-3
d_m = Effect of mth paritym = 1-5 and 6
g_n = Effect of nth gestation period = 1-4 and 5
$e_{ijklmno}$ = Error associated with the $X_{ijklmno}$ and is assumed to be distributed normally with mean zero and constant variance

Duncan's multiple range test as modified by Kramer (1957) was used for testing the differences among least squares means (using the inverse coefficient matrix). Paternal Half sib correlation method was used for estimation of heritability of birth weight.

RESULTS AND DISCUSSION

The least square mean for birth weight of calves was found to be 27.83±0.48 kg. The result of the combined least squares analysis of variance to study the effect of various factors on birth weight is shown in Table 1. Except for the season of calving all other factors included in the study viz. year of calving, parity of dam, sex of calf, gestation length of dam and sire of calf had statistically significant effect on birth weight of calves.

The mean birth weight of calves grouped in to different factors viz., season of calving, year of calving, sex of calf, parity of dam and gestation length of dam is shown in Table 2.

The effect of sires on the birth weight of calves was found to be statistically significant ($p<0.05$) and the heritability value estimated for birth weight was 0.19±0.09. The results of the present study revealed that the overall mean birth weight of crossbred calves maintained at Cattle Breeding Farm, Thumburmuzhi was 27.83±0.48 kg which is well comparable with the average weight of crossbred cattle of India. But Bakir *et al.* (2004) and Bayram and Aksakal (2009) reported a higher body weight of 38.09 kg and 42.76 in the progenies of Holstein Friesian cattle.

Table 1: Combined least squares analysis of variance for birth weight

Source	DF	Sum of squares	Mean squares	F-value
Sex of calf	1	270.87	270.87	23.796**
Year of calving	10	219.84	21.98	1.931*
Season of calving	2	52.56	26.28	2.309
Parity of dam	5	305.26	61.05	5.363**
Gestation length of dam	4	131.71	32.93	2.893*
Sire of calf	69	1620.09	23.48	2.063**
Reminder	621	7068.81	11.38	

*Significant at 5% level ($p<0.05$); **Significant at 1% level ($p<0.01$)

Table 2: Least squares means of birth weight grouped for various factors

Factors	N	Least square mean	SE
Overall mean	713	27.83	0.48
Sex of calf			
Male	369	28.50^{a}	0.50
Female	344	27.16^{b}	0.50
Year of calving			
1995	62	28.79^{efg}	0.89
1996	48	28.32^{def}	1.24
1997	71	26.31^{ab}	0.93
1998	43	27.32^{bcd}	1.02
1999	76	28.46^{efg}	0.75
2000	73	29.64^{g}	1.03
2001	78	27.86^{cde}	0.99
2002	87	27.05^{abc}	0.78
2003	66	26.07^{a}	1.25
2004	62	27.69^{cde}	1.19
2005	47	29.05^{fg}	1.27
Season of calving			
Summer	213	27.30	0.56
Rainy	333	28.24	0.52
Winter	167	27.94	0.58
Parity of dam			
1st	197	26.81^{a}	0.51
2nd	154	28.51^{c}	0.53
3rd	121	28.53^{c}	0.55
4th	85	28.38^{c}	0.60
5-8	140	27.71^{bc}	0.54
9 and above	16	27.03^{ab}	1.01
Gestation length of dam			
Below 271 days	42	27.25^{a}	0.72
271-275 days	100	27.24^{a}	0.59
276-280 days	200	28.27^{bc}	0.52
281-285 days	195	27.81^{ab}	0.52
Above 285 days	176	28.57^{c}	0.53

Akbulut *et al.* (2001) also reported a birth weight of 38.8, 36.5 for Brown Swiss 37.6 and 36.3 for Holstein Friesian male and female calves, respectively. Whereas Mathai *et al.* (1978) reported a birth weight of 17.22 kg for the crossbred cattle maintained at the same station which was much lower than the reported values. This clearly indicates that the progenies of the Holstein Friesian and Jersey breeds are heavier at birth than the indigenous non descript calves and crossing the zebu non descript with these exotic breeds will definitely increase the birth weight of the calves. The increase in the average birth weight of crossbred calves from 17.22-27.83 kg over a period of 27 years as a result of crossbreeding strongly supports the above fact.

The mean birth weight of male and female calves was 28.50±0.50 and 27.16±0.50 kg, respectively. The male calves were heavier at birth than the female calves; the average difference was 1.34 kg (4.7%). This result is supported by the results obtained by Marquez *et al.* (2001) and Bakir *et al.* (2004) who reported an average difference of 5.25 and 0.06%, respectively.

The analysis of variance showed that the sex of calf was found to have highly significant ($p<0.01$) influence on the birth weight of crossbred calves (Table 1). This confirms the earlier results published by of Mathai *et al.* (1978), Marquez *et al.* (2001), Akbulut *et al.* (2001). However, Bakir *et al.* (2004) reported that the effect of sex on birth weight was not significant.

The effect of year of calving on birth weight of calves was statistically significant ($p<0.05$). As observed in the present study, the significant effect of year on weight at birth was reported by Akbulut *et al.* (2001) and Bakir *et al.* (2004). The later also reported that because of changes occur in climate and pasture conditions from year to year, the differences in the calf birth weight are expected and the same may hold true in the present study also.

The average birth weight of calves born during summer, rainy and winter was found to be 27.30±0.56, 28.24±0.52 and 27.94±0.58, respectively (Table 2). The maximum birth weight was noted in rainy season born calves and minimum in summer born calves. The differences in birth weight due to season was found to be non significant. This finding is akin to the reports made by Anderson and Plum (1965), Mathai *et al.* (1974), Mathai and Raja (1976), Ornelas and Ponce (1984) and Akbulut *et al.* (2001) who observed no significant variation in birth weight of calves born during different seasons. However, Singh and Ray (1961) and Mathai *et al.* (1978), Shibata and Kumazaki (1984), Sang and Kim (1986), Ulusan (1992) and Bakir *et al.* (2004) reported significant effect of season of calving on birth weight.

The effect of parity of dam on birth weight was found to be highly significant ($p<0.01$). The lowest birth weight has been observed in first parturition. However the mean birth weight was appeared to be more or less similar between third and fourth parturition and started declining in the subsequent parities. The same trend was noticed by Bakir *et al.* (2004) who reported that the effect of parity of dam on weight at birth was significant. This result is also supported by Kaygisiz (1998). However, Freitas *et al.* (1988) found that parity had no significant effect on birth weight. He also reported that the birth weight was lowest in calves born by 2 years age of dam and increased rapidly at 3 years. This increase happens gradually until dams reached 5-6 years of age and then the birth weight decreased until 9-11 years of age.

From the Table 1 it can be noted that the effect of gestation length on birth weight was statistically significant ($p<0.01$). The maximum birth weight was noted when the gestation period was >285 days and was less when the gestation period was <275 days (Table 2). This result is supporting the earlier reports by Mathai *et al.* (1978) and Bakir *et al.* (2004). On the basis of these results it can be concluded that birth weight is influenced by the length of gestation and that cows which tend to carry calves over time that is longer than the mean gestation period for the breed tend to have heavier calves than those that carry their under time.

The sire of calf had highly significant influence ($p<0.01$) on the birth weight of calves (Table 1). Estimates of heritability are essential population parameter required in animal breeding research and in the design and application of practical breeding. The heritability of weight at birth estimated in the present study was moderate with a value of 0.19±0.09. But Kaygisiz (1998) reported a much lower heritability estimate of 0.078 and 0.084 for Simmental and Brown Swiss cattle, respectively. The heritability estimate reported by Bakir *et al.* (2004) in Holstein was also lower (0.13) than this value. On the other hand the heritability estimates of 0.34 and 0.24 reported by Guaragna *et al.* (1990) and Akbulut *et al.* (2001), respectively in the Holstein breed were higher than the value found in the present study.

CONCLUSION

The result of the combined least squares analysis of variance showed that the sire of calf, sex of calf and parity of dam had highly significant ($p<0.01$) effect while the year of calving and gestation length had statistically significant ($p<0.05$) effect on birth weight of calves and the season of calving had no significant effect. The heritability value for birth weight of calves was estimated as 0.19±0.09.

REFERENCES

Akbulut, O., B. Bayram and M. Yanar, 2001. Estimates of phenotypic and genetic parameters on birth weight of brown Swiss and holstein friesian calves raised in semi intensive conditions in Turkish. Lalahan Hay Arst Derg, 41: 11-20.

Anderson, H. and M. Plum, 1965. Gestation period and birth weight in cattle and buffalo. J. Dairy Sci., 48: 1224-1235.

Bakir, G., A. Kaygisiz and H. Ulker, 2004. Estimates of genetic and phenotypic parameters for birth weight in Holstein Friesian cattle. Pak. J. Biol. Sci., 7: 1221-1224.

Bayram, B. and V. Aksakal, 2009. Estimates of genetic and phenotypic parameters for the birth weight of calves of holstein friesian cattle reared organically. J. Anim. Vet. Adv., 8: 568-572.

Farrel, C., 1993. Factors influencing fetal growth and birth weight in cattle. Beef Research Progress Report No. 4, pp: 104-107. http://agris.fao.org/agris-search/search/display.do?f=1995/v2107/US9448815.xml;US9448815.

Freitas, R., R. Vaccaro and R. de Freitas, 1988. Factors affecting birth weight and gestation length in dairy cattle. Anim. Breed. Abst., 56: 25-25.

Goyache, F., I. Fernandez, I. Alvarez, L.J. Royo and J.P. Gutierrez 2002. Gestation length in the Asturiana de los vallies beef cattl breed and its relationship with birth weight and calving ease. Arch. Zootec., 51: 431-439.

Guaragna, G.P., G.G. Cameiro, J.R. Torres and L.B. Gambini, 1990. Effect of environmental and genetic factors on birth weight of Holstein cattle. Bull. de Ind. Anim., 47: 19-30.

Harvey, W.R., 1990. User's Guide for Mixed Model Least Squares and Maximum Likelihood Computer Program (PC-2 version), USDA-ARS. Ohio State University, Columbus.

Kaygisiz, A., 1998. Estimates of genetic and phenotypic parameter for birth weigth in brown and simmental calves raised at altindere state farm. Turk. J. Vet. Anim. Sci., 22: 527-535.

Kramer, C.Y., 1957. Extension of multiple range tests to group correlated adjusted means. Biometrics, 13: 13-18.

Marquez, A.P., A.C. Correa, J.F. Ponce, J.G. Rodriguez and F.B. Fierro *et al*., 2001. Estimates of genetic parameters of calf birth weight and calving difficulty in Limousin cattle. Proc. Western Section Am. Soc. Anim. Sci., 52: 1-4.

Mathai, E. and C.K.S.V. Raja, 1976. A study on the growth rate and age at puberty of Jersey-Sindhi females under different regime of feeding. Kerala J. Vet. Sci., 7: 114-123.

Mathai, E., E.T. Jacob, K.C. Abraham and B.R.K. Nair, 1978. Studies on certain factors influencing birth weight in Sindhi and Jersey grades. Kerala J. Vet. Sci., 9: 5-14.

Mathai, E., U.T. Francis and C.K.V.S. Raja, 1974. A comparative study on the birth weight of Sindhi and Jersey-Sindhi calves. Kerala J. Vet. Sci., 9: 5-14.

Ornelas, G.T. and H.R. Ponce, 1984. Some environmental effects on birth of holstein friesian and brown swiss calves in the tropics. Anim. Breed. Abstr., 52: 6315-6315.

Sang, B.C. and C.K. Kim, 1986. Repeatability estimates of gestation length and birth weight and the environmental effects on these traits in dairy cattle. Korean J. Anim. Sci., 28: 184-187.

Shibata, T. and K. Kumazaki, 1984. Studies on the development of improved stains of Japanese beef cattle. 2. Genetic and environmental effects on reweaving growth of Japanese brown calves. Anim. Breed. Abst., 52: 7116-7125.

Singh, R.S. and S.N. Ray, 1961. Studies on the gestation period of dairy cows. Indain J. Dairy Sci., 4: 1-7.

Ulusan, H.O.K., 1992. The change of calf growth accordoring to birth season and repeatibility of birth weight in brown swiss cattle raised in elazig sugar factory farm. Uludag Üniv. Vet. Fac. Derg., 11: 57-67.