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USING LEAST SQUARED METHOD TO ESTIMATE THE MAGNITUDE OF VARIOUS ENVIRONMENTAL SOURCES OF VARIATION INFLUENCING BIRTH WEIGHT IN LOHI SHEEP BREED

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ABSTRACT: *Data on 3984 lambing records of 1285 Lohi ewes kept at the Livestock Experimental Station, Bahadurnagar, Okara for the period 1980-2011 were analyzed by using Harvey's Mixed Model Least Squares and SPSS Computer Programme. The purpose was to estimate the magnitude of various environmental sources of variation influencing birth weight in this breed of sheep. The least squares mean for birth weight was 3.60± 0.03 kg. The trait was significantly (P< 0.01) & (P< 0.05) influenced by the year and season of birth, type of birth and the sex of the lamb born. The age of the dam also had significant effect on birth weight of the lamb; the younger ewes produced lighter (3.48 ± 0.03 kg) lambs than older ewes (3.69 ± 0.03 kg).*

KEYWORDS: Lohi sheep, birth weight, environmental factors.

INTRODUCTION

The Lohi breed is the biggest and most productive of all the breeds of sheep in Pakistan. It comprises some 40% of the Punjab and 15% of the national sheep production (GOP, 2011). The Lohi breed belongs to the irrigated areas of the central Punjab but is wide-spread in other regions of the province also. There is a wide diversity in various production traits of this breed which suggests that there is a great scope for improvement of performance traits. This diversity in performance traits could be due to several genetic and environmental influences.

Any breed development programme is based on the exploitation of genetic variation. The variation in body weight, productive and reproductive parameters and wool yield can be skillfully exploited if the extent of genetic and environmental causes of variation in these traits is precisely known. The observed performance of each animal in each trait is the result of the heredity that it receives from both parents and the environment in which it is raised. Even when an attempt is made to provide a uniform environment, there are still accidental and unknown environmental differences between animals. Such random environmental factors thereby cause differences in the expression of economically important traits. Performance records of animals should be adjusted to reduce or discount known environmental differences between animals so that genetic differences among animals can be recognized and used for effective breeding plan for improvement. Adjustment should be made for environmental and physiological sources of variation such as age, sex, birth type, years, seasons and such other environmental variables that can be assessed or evaluated. Genetic differences between animals do exist but large environmental differences make the evaluation of such genetic differences extremely difficult.

A study was thus planned on Lohi sheep to measure the effect of known environmental factors which laid to obscure the genetic differences among animals for birth weight.

MATERIALS AND METHODS

The data on 3984 lambs born from 1285 Lohi ewes sired by 90 rams kept at the Livestock Production Research Institute, Bahadurnagar, Okara during 1980-2009 were utilized to estimate the effect of environmental factors affecting birth weight. The data were analysed to estimate the effect of year and season (spring and autumn) of birth of lamb, age of the dam, birth type (single, multiple) and sex (male, female) of lamb born. The dams were grouped into three age groups on the basis of their age at lambing i.e., young (< 3.5 years), mature (3.5 to *5.5* years) and old (> 5.5 years). The mathematical model assumed for the Least-Squares Analysis was:

$$Y_{ijklmn} = \mu + P_i + S_j + A_k + T_l + X_m (AT)_{kl} + (TX)_{lm} + \varepsilon_{ijklmn}$$

i = 1, 2, 3,…….., p (Number of years = 30)

j = 1, 2 (Number of seasons = 2)

k = 1, 2, 3 (Age groups of dams = 3)

l = 1, 2 (Number of birth type = 2)

m = 1, 2 (Sex of the lamb born = 2)

Y_{ijklmn}	=	birth weight of n^{th} lamb of m^{th} sex l^{th} birth type and k^{th} age of dam and born during j^{th} season in i^{th} year
μ	=	overall population mean
P_i	=	effect of i^{th} year
S_j	=	effect of j^{th} season
A_k	=	effect of k^{th} age of the dam
T_l	=	effect of l^{th} type of birth
X_m	=	effect of m^{th} sex of lamb born
$(AT)_{kl}$	=	effect of interaction between k^{th} age group and l^{th} birth type
$(TX)_{lm}$	=	effect of interaction between l^{th} birth type and m^{th} sex of the lamb
ε_{ijklmn}	=	Random error associated with birth weight of n^{th} lamb of m^{th} sex, l^{th} birth type and born to dam of k^{th} age during jth season of i^{th} year. It was further assumed that ε_{ijklmn} was normally and independentlydistributed with mean zero and variance σ^2

The birth weight data represented unequal disproportionate subclass frequencies and were, thus, analysed by using Harvey's Mixed Model Least Squares and Maximum Likelihood computer programme (Harvey, 1990).

RESULTS AND DISCUSSION

Overall least squares mean for birth weight was 3.60+ 0.03 kg with the coefficient of variation of 16.78%. The effects of year and season of birth, age of dam, birth type and sex of lamb on the birth weight of lambs were determined. Mean birth weights in each category of factors influencing the trait are shown in Table 1 and the analysis of variance for the significance of these factors is given in Table 2. The birth weight varied significantly (P < 0.01) among the years and seasons of lambing. The means for this trait varied widely in different years, the range being 3.25 ± 0.03 kg in 2007 to 3.87 + 0.04 kg in 1982. There was no specific trend for this trait across the years but the means were generally lower in the period after 2000.The level of management is bound to vary according to the ability of the farm manager, his efficiency in the supervision of staff, availability of financial resources and culling strategies. Selected and adequately fed ewes are expected to produce heavy lambs. The variation in birth weight observed in different years reflected the level of management as well as some environmental effects on the ewes during pregnancy. The management at farm must have changed frequently and its effects reflected in performance traits. Availability of feed and fodder must not had been the same over the 30 years period due to rains and several other factors which could have affected productivity of animals in different years. This variation could also be due to genetic trends in trait which showed a decline since inception of the flock.

As we see the mean birth weight was higher among lambs born during spring than those born in autumn season Table 1. The spring born lambs might be heavier at birth than autumn born due to availability of good quality fodder for the ewes during late winter and during spring than summer season. The ewes lambing during autumn had greater part of their pregnancy during summer season which could have affected their overall performance including the growth of lambs in the mother's wombs.

The older ewes produced the heaviest Table 1 lambs. Increased birth weight of lambs due to increasing age of the ewes reflects physiological phenomena, that is, the size of ewes' as well as the uterus where the foetus is to be nourished is increased. The age of the dam also had significant effect (P<0.01) on birth weight of the lamb born. Younger ewes produced lighter lambs and the birth weight of lambs increased with advancing age of their dams. Also younger ewes develop in size and weight and hence utilize energy for their own growth and development which might affect the birth weight of lambs produced by them. Contrarily, older ewes had already attained their full growth and can divert their all energies for productivity. Hence, the older ewes probably produced the heaviest lambs.

The birth weight was also significantly affected (P < 0.01) by the type of birth and the sex of the lamb born. Single born lambs were heavier than multiple born lambs. The male lambs were also heavier at birth than female lambs Table 1. Single born lambs had better opportunities in the mother's wombs than the twins or triplets and were hence heavy at birth. The male lambs generally stay slightly longer in mother's womb than females and hence heavier at birth.

A number of workers reported that the birth weight of lambs differed significantly due to year and season of birth, age of the dam, birth type and sex of lamb born. Farid and Makarechian (1976) reported that year of birth and sex of the lamb significantly influenced the birth weight in Karakul, Mehraban, Neimi and Bakhtiari lambs. Combellas *et al*. (1980) reported significant effect of year on birth weight in West African and Black Headed Persian breed of sheep. Unal and Akcapinar (2001) reported that the effect of birth year, age of dam, sex and type of rearing on birth weight was significant.

Table 1: Least squares means (LSM) and standard error (SE) of birth weight of lambs

Classification	No. of records	LSM ± SE (kg)	Classification	No. of records	LSM ± SE (kg)
Overall	**3984**	3.6 ± 0.03	**2006**	128	3.36 ± 0.05
Years			**2007**	60	3.25 ± 0.03
1980	23	3.68 ± 0.05	**2008**	51	3.27 ± 0.04
1981	25	3.64 ± 0.04	**2009**	36	3.35 ± 0.06
1982	33	3.87 ± 0.05	**2010**	54	3.35 ± 0.04
1983	40	3.7 ± 0.10	**2011**	62	3.37 ± 0.07
1984	54	3.66 ± 0.03			
1985	89	3.72 ± 0.06	**Seasons**		
1986	117	3.74 ± 0.02			
1987	151	3.81 ± 0.03	Spring	3149	3.77 ± 0.04
1988	169	3.7 ± 0.03	Autumn	835	3.42 ± 0.03
1989	178	3.76 ± 0.04			
1990	174	3.46 ± 0.02	**Age of dam**		
1991	160	3.75 ± 0.07			
1992	174	3.69 ± 0.05	Young	2121	3.48 ± 0.02
1993	136	3.63 ± 0.04	Mature	1410	3.62 ± 0.02
1994	138	3.61 ± 0.04	Old	453	3.67 ± 0.03
1995	152	3.58 ± 0.03			
1996	140	3.64 ± 0.02	**Birth type**		
1997	163	3.69 ± 0.03			
1998	188	3.49 ± 0.04	Single	2101	3.94 ± 0.02
1999	191	3.85 ± 0.03	Multiple	1883	3.24 ± 0.03
2000	172	3.21 ± 0.02			
2001	194	3.46 ± 0.02	**Sex of lamb**		
2002	207	3.32 ± 0.03			
2003	218	3.35 ± 0.02	Male	2053	3.69 ± 0.02
2004	203	3.36 ± 0.02	Female	1931	3.48 ± 0.02
2005	220	3.61 ± 0.02			

Table 2: Least-squares analysis of variance for birth weight

Source of Variation	df	Mean Square	F
Years	29	1.92	5.05**
Season	1	103.32	271.89**
Age of dam	2	11.01	28.97**

Birth type	1	217.62	572.68**
Sex of the lamb	1	44.82	117.95**
Age x birth type	2	1.48	3.89*
Birth type x sex	1	0.2	0.53[NS]
Remainder	3946	0.38	
*** Significant (P < 0.05),**	**	Significant (P < 0.01),	NS = Non-significant

Kornal *et al.* (1976) observed that the birth weight in Corriedale lambs was significantly affected by sex and birth type. Combellas *et al.* (1980) reported significant effect of sex and birth type on birth weight in West African and Black-Headed Persian breed of sheep. According to Ghoneim *et al.* (1982), birth

weight in Awassi lambs was affected by sex and birth type. Abouheif and Alsobayel (1983) also recorded a significant effect of year of birth, sex and birth type on the birth weight of Najdi lambs. EI-Karim and Owen (1988) reported that year of birth, sex of lambs, type of birth and age of dam were the environmental factors which affected birth weight in Shugot and Watish breeds of sheep. Wojtowskt *et al.* (1990) found that effect of year and month of birth, type of birth (single, twin or triplet), sex, and age of dam were significant on birth weight.

The results of the present study, however, differed from the findings of several other workers. Ghoneim *et al.* (1982) reported that birth weight in Awassi lambs was not significantly affected by year of birth. Berra and Paimondi (1986) noted that sex had no effect on birth weight of lamb. Similar results were also reported by Maui and Rodricks (1987) and Tizikara and Chiboka (1989). Botswana (1986) and Lima *et al.* (1987) reported that season of birth (spring or autumn) had no significant effect on birth weight. These results might be due to uniform management and feeding practices which probably did not exist in the flock under study.

The results of the present study revealed that environmental factors cause differences in the expression of economically important trait like birth weight. Performance records of animals should be adjusted to reduce or discount known environmental differences between animals so that genetic differences among animals can be recognized and used for effective breeding plan for their improvement.

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